Florence Bretelle-Establet *Editor*

VOLUME 265 BOSTON STUDIES
IN THE PHILOSOPHY OF SCIENCE

Looking at it from Asia: The Processes that Shaped the Sources of History of Science

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VOLUME 265

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Looking at It from Asia: The Processes that Shaped the Sources of History of Science

Edited by

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ISBN 978-90-481-3675-9 e-ISBN 978-90-481-3676-6
DOI 10.1007/978-90-481-3676-6
Springer Dordrecht Heidelberg London New York

Library of Congress Control Number: 2010926129

Printed on acid-free paper

Springer is part of Springer Science + Business Media (www.springer.com)

Acknowledgements

This volume is one of the results of a collaborative project that started in 2003 between a small group of historians working on the history of science in ancient and early modern Asia and sharing a common interest in the issues of the historiography of science. This project began as a collective reflection on the question of the unequal treatment written documents had undergone in the historiography of science in Asia. The financial support provided by the French Ministry of Research (*ACI Jeunes Chercheurs: "Corpus de textes scientifiques: Histoires et perspectives théoriques"*) allowed us to transform our former questions about sources into a more constructed problematics and to widen the contexts in which this problematics could be raised by inviting researchers from different continents. A REHSEIS seminar—*Histoire des sciences en Asie* (history of Science in Asia)—and two international workshops provided the framework of these debates. The first workshop was held in 2005 and focused on the issue of collections—"*Bibliothèques, encyclopédies, musées, archives: la constitution des collections qui ont fourni ses sources à l'histoire des sciences*" (Libraries, encyclopedias, museums, archives: the shaping of the collections that provided the sources for the history of science). The second was held in September 2006 and provided the opportunity to determine the organization and the content of this book.

This volume owes its success to different people to whom I would like to express my gratitude. Following the chronological order of the genealogy of this book, my thanks first go to my closest colleagues of REHSEIS, Andréa Bréard, Karine Chemla, Catherine Jami, Agathe Keller, and Christine Proust, who constantly supported this project, generously gave me the benefit of their extensive international network and accepted to help me in the editorial work of the book; my thanks then go to all the contributors of this volume, Andréa Bréard, David Brown, Karine Chemla, Chu Pingyi, Philippe Clancier, Donald Harper, Catherine Jami, Agathe Keller, Christopher Minkowski, Christine Proust, Dhruv Raina, and Michele Thompson for their research, their cheerful input into this collective book and their patience. I am also grateful to the anonymous referee for his/her helpful comments. Although they did not

contribute to this book, a number of scholars invited by REHSEIS in the last four years also nourished our investigations and must be personally thanked for this reason: Catherine Despeux, Pierre-Sylvain Filliozat, Han Qi, Marc Kalinowski, Isabelle Landry-Deron, Kathryn Lowry, Martina Siebert, Paul Unschuld, and Niek Veldhuis. Finally, this collective book includes many authors who are not English native speakers and needed to have their contribution polished. My thanks thus also go to Richard Kennedy, Micah Ross Theodora Seal, Maurice Shukla, and Michele Thompson for their polishing and rewriting work.

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Chapter 1

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Introduction
How do Documents Become Sources? Perspectives from Asia and Science

Florence Bretelle-Establet

From Documents to Sources in Historiography

The present volume develops a specific type of critical analysis of the written documents that have become historians' sources. For reasons that will be explained later, the history of science in Asia has been taken as a framework. However, the issue addressed is general in scope. It emerged from reflections on a problem that may seem common to historians: why, among the huge mass of written documents available to historians, some have been well studied while others have been dismissed or ignored?

The question of historical sources and their (unequal) use in historiography is not new. Which documents have been used and favored as historical sources by historians has been a key historiographical issue that has occupied a large space in the historical production of the last four decades, in France at least. This reflection developed within a context in which, particularly from the 1970s onwards, some historians began to analyze to what extent historical production since the first decades of the twentieth century has developed a *Nouvelle histoire* in France and abroad. In 1978, Jacques Le Goff edited a synthesis of these historiographical reflections. Let us rely on the diagnosis offered by Le Goff's book to grasp how historians of the first half of the twentieth century changed their conception of sources and their use of documents. The diagnosis underlined how the change that happened in the discipline in the beginning of the twentieth century led historians to raise new issues. Nourished by the emerging social sciences, and aware of the questions and methods of these disciplines, historians, particularly those who gathered around the so-called "Annales school," opened historiography to fields of inquiry that had mainly remained, until then, outside their realm. Following in the footsteps of former philosophers or historians like Voltaire or the less famous Legrand d'Aussy, author of *Histoire de la vie privée des Français depuis l'origine de la nation jusqu'à nos jours* in 1783, the practitioners of the new school systematically moved away from a historiography mainly concerned with "great" political events and "great" political figures.

Economy, demography, material life, mentalities, human representations or emotions became new objects of inquiry as did the common man and, in the aftermath of 1968, outcasts, exiles, and women. This change in the objects of inquiry launched a search for materials that would enable historians to answer the new questions. As a result, historians of the twentieth century contributed to the discovery or rediscovery of materials that had been marginalized in historiography. On the one hand, documents like price lists and fiscal documents such as testaments that provided evidence for the day-to-day life of what had been until then an anonymous mass, emerged from the darkness in which they had been cloaked and allowed historians to raise new issues.[1] On the other hand, documents previously used for certain purposes were read with new concerns in mind. For example, to make the voice of the silent actors of history heard, sources that had been explored earlier were read from other viewpoints. For instance, judicial and jail archives, hence official discourses, allowed recovery of part of the language of silent criminals.[2] Further, to fill the gap in written records, historians widened the set of evidence considered as relevant for historiography including thereby archaeological findings, iconographical documents and oral inquiries.[3] The very notion of historical source was thus reexamined in the twentieth century by historians whose objects of inquiry had changed. This change was one reason for the resurgence of documents of the past that had once been marginalized in historiography. This (re)discovery and renewed interest in these documents was thus linked with the "new" preoccupations, with the "new" issues raised by historians. As such historians could state: "History is the child of its time" *(l'histoire est fille de son temps)*, the historical questions and the selection of documents that could be used to address them being inevitably anchored in the historian's own time.[4]

In this critical analysis of the use of documents of the past, which is also the object of our present inquiry, some historians, particularly those involved in women's studies, pinpointed other factors that happened *prior to* the historian's task of raising questions and shaping a corpus. Historians of women's studies pointed out that written documents had been unequally produced in history. In the case they addressed, gender relations had conditioned the very existence of

[1] (Le Goff 1978, 55; Marrou, in Samaran 1961, 1465–1539, and particularly 1471-1475)

[2] (Schmitt 1978, 298-299)

[3] (Le Goff 1978, 38)

[4] (Braudel [1969] 1982, 6). Braudel did use the word "histoire" which was thus translated into "history" in the English version of his book. However, by reading the whole chapter from which this short sentence is extracted, one can see that he used this word not for designating "the history" in its meaning of "the past as it had actually occurred", but rather in the sense of the writing of the history. The term historiography would probably fit what Braudel meant to say better but this latter word was not very commonly used in the 1960s. It is likely that "historiography" became more widely used when postmodern ideas forced historians to reevaluate their relationship to their subjects and to question the very possibility of an objective history. On these changes, see (Iggers, [1997] 2005).

documents on women. "The only voices we hear are those of men. Not all men; the vast majority were condemned to silence. The written word was controlled by the clergy, men of the cloth and of the Church who controlled the flow of knowledge and determined how people conceived of women, or, rather, of Woman".[5] Therefore, for a long time, we have had a lot of discourses about and images of women, among them, the image of an unrepentant chatterbox, but all of them come from men. Until the end of the thirteenth century, these historians stress, nearly nothing from women's so-called chattering has come down to us.[6] Women had no access to the cultural tools that would have enabled them to present in long-lasting documents their own activities and representations. This has been true of other groups as well including the vagabonds, obscure criminals, sorcerers or prostitutes subsumed by Schmitt under the label "marginaux" (outcasts) and peoples without a script.[7] Therefore, historians lacked precise documents produced by such marginalized actors while overabundant writings about them written from the outside were available. Taking women's history further as an example, historians have pinpointed that even when women started to produce written documents, since their writings mainly concerned private and domestic life, they were not preserved as well as those dealing with public life and produced by men. "Preservation of women's memory is another difficult issue. In the theater of memory, women are mere phantoms. They take up little space on the shelves of public archives and have suffered from the widespread destruction of private archives".[8] Further, of the documents written by women those pertaining to private life were not preserved equally: diaries, private letters, account books were often discarded while poetic or philosophical writings were more commonly preserved.

What this detour via women's historiography tells us is that in addition to having remained outside the main historical questions for a long time, and having been silent actors of history for an equally long time, women produced written records that were submitted to unequal treatment regarding their preservation, circulation, and promotion. This is precisely the issue we address in this book. If undoubtedly, "history is the child of its time", we argue that by relying on documents of the past that have a history of their own, it is also the child of its past.

An Issue Addressed Within the Context of Science and Asia

As previously noted, any historian's research is grounded in his/her own time. Historiography of knowledge, which is the frame of the present research, testifies to this phenomenon. It explains, at least partly, why historians have

[5] (Duby, Perrot, Klapish-Zuber 1992, 2:7)
[6] (Duby, Perrot, Klapish-Zuber 1992, 2:483)
[7] (Schmitt 1978, 298)
[8] (Duby, Perrot, Schmitt Pantel 1991, 1:14)

not paid the same attention to all documents of the past. A striking example is provided in this book by David Brown who analyzed Mesopotamian tablets that were exhumed in the late nineteenth century. He shows how the ideological background and scholarly agendas of Assyriologists in the nineteenth century influenced their ways of considering the tablets they had at hand. The different values given to the different branches of knowledge by observers of the nineteenth and twentieth centuries—or in other words, their classification of knowledge and its hierarchical organization—led them to grant more or less importance to the different Mesopotamian tablets available to them. Brown notes that for the historians of science non-astronomical astral science was viewed as "wretched" or "rubbish". Until recently, only certain texts among the cuneiform astronomical texts were considered worthy of study while others, of an apparently more astrological nature, have been overlooked. Thus, few astrological texts have been edited to date.

Intellectual preoccupations at certain points in time undoubtedly dictated priorities as regards historical questions and research; this, in turn, promoted specific sets of the documents of the past that dealt with certain types of knowledge while confining others to the margins of scholarship. In this field as well, *history is the child of its time*. In science this holds perhaps more true than in any other field of knowledge for many reasons. For example, let us stress that the notions of modernity and progress with which science, in Europe, came to be associated, from the seventeenth century onwards, had the consequence of leading people who were involved in the making of science to evaluate and hierarchize the theories and practices elaborated in earlier times.[9] The classification and hierarchical organization of the sciences were even more emphasized in the following centuries, particularly when, in the early nineteenth century, the nature of science became a contentious issue which gave rise to a "metascientific discourse" among different people involved in the making of science who also attempted to define it. The conception of the three stages of intellectual development—the theological, the metaphysical and the positive or scientific stages—defined by Auguste Comte in France and the elaboration of a 3-stage model of scientific progress that went through a "prelude", an "inductive epoch", and a "sequel"—developed in Great-Britain by William Whewell—testify to this growing hierarchical organization of knowledge linked to scientific activities. Note that Comte and Whewell provided the main intellectual framework in Europe for defining the emerging scientific disciplines in the nineteenth century.[10] This hierarchical organization of science became even more acute as scientific discoveries and inventions became powerful symbolic tools used not only to proclaim the superiority of

[9] On the conviction that philosophers of the seventeenth century had concerning the modernity of their ways of reflecting on the world, see (Shapin 1996, chap.2)
[10] (Yeo [1993], 2003)

one nation against others but also to legitimize the colonial enterprise.[11] All these factors in the nineteenth century led to emphasizing strong classifications, hierarchical organization and separations in the sciences that then included “infant”, “less complete” and “mature” sciences.[12] Undoubtedly these classifications had an impact on the historiography of science. In the nineteenth and twentieth centuries, historians relied on these classifications and on the hierarchical organization of science to delineate the documents of the past that pertained to science and the ones that did not. In this context, the documents that didn’t fit in whether geographically or conceptually were set aside. This was the case with the non-astronomical astral science tablets just mentioned. On a larger scale, this was the case of documents produced outside the “West”. Indeed, for many historians of science of the first two thirds of the twentieth century, “science” was synonymous with “Western science”. Contributions from Asia have been for a long time marginalized with regard to the mainstream genealogy of science.[13] Moreover, when science produced outside Europe or the United States started to be analyzed historically, it was usually through the lens of eurocentric conceptions of what was science, and what were scientists and scientific texts.[14] The classifications and hierarchical organization of science in the nineteenth and twentieth centuries have thus largely influenced the way documents of the past were considered by historians at the beginning of the history of science as a discipline.

However, the fact that Asian documents of the past that bear witness to scientific activities have been overlooked by historians of science is not solely related to the inevitable anchorage of historians’ agendas in their own time and, in this particular case, to the modern construction of the East-West dichotomy. Asian documents indeed had a long history before they were used in this context. Integrating their early history into our enquiry brings to the foreground the various actors who, over centuries, constructed, collected and promoted texts

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[11] As Paolo Brenni has convincingly shown in his plenary lecture “The Combersome Material Heritage of Astronomy (23rd International Congress of History of science and Technology, Budapest, 2009)”, the ever growing size and magnificence of the astronomical observatories built in Europe during the nineteenth century attests to this acute competition for national prestige.

[12] (Yeo [1993], 2003, 96, 106).

[13] The number of pages devoted to the history of science in China (7), Japan (7) and India (5) in the 727 page book *la science moderne* (1958), which in its days was an authority in the field, is a striking example of the eurocentric historiography of sciences in the mid-twentieth century.

[14] In the past forty years, as the “Western” hegemonic vision of the rest of the world has increasingly been disputed, the field of the history of “non-Western science” has been considerably renewed. Whether this change is due to the development of area studies in the 1960s, or gender studies in the 1970s, or post-colonial studies in the 1980s, in any case, the historiography of science has come to be more inclusive (Low 1998, 1-8). This change stresses here again that the practice of history is time dependent and that historians explore the past with the preoccupations of their own days.

as part of their cultural and historical identity. For example, in China, the state collected and catalogued manuscripts throughout the empire; it commissioned compilations of excerpts of extant texts; when printing developed, it became a central publisher. It thus played a crucial role in securing the transmission from generation to generation of documents that were deemed relevant, leaving others to oblivion.[15] The official bibliographies listed in the dynastic histories, as witnesses of the past and models for posterity, give further evidence of the imperial state's long-lasting endeavor to collect, select and hierarchize texts. The contributions dealing with China in this volume will provide more evidence of the role of the imperial rule in these processes of selection and promotion. What this example from the Chinese world stresses is that upstream from the historian, her/his time-dependent historical questions and her/his subsequent selection of documents, other actors have been at play in the material and social life of the documents of the past.[16]

These remarks allow us to introduce the issues at stake in the present volume: its aim is to shed light on the different actors and factors that affected the life of documents after they were produced. In other words, it examines different kinds of manipulation and selection that written documents have undergone in history. It examines the processes that—prior to the historian's first act of *mettre à part (setting aside)*[17]—led to the fact that some part of these documents had already been given a special status and a particular shape. Moreover, the volume intends to highlight the impact these early manipulations and selections had on historiography. These questions are general; they are by no means specific to the Asian world. However, focusing on the Asian world is of particular interest, since the written documents produced in Asia have been in the hands of at least two very distinct kinds of actors: on the one hand, Asian actors; on the other, from the seventeenth century onwards, European and American actors as diverse as missionaries, royal librarians, merchants, colonial administrators and archaeologists. As

[15] On the role played by the state, in China, in securing and promoting a bouquet of documents of the past, see (Cherniack 1994; Kurz 2001; Bretelle-Establet and Chemla 2007; Huters, et al.1997 and Guy 1987)

[16] The expression "social life of documents" is used by John Seely Brown and Paul Duguid in their essay *The Social Life of Documents*, 1996, which attempts to give a broader idea of what a document is and also emphasizes how and why it has a future as well as a past. Paul Unschuld gave a particularly illustrative example of this in his communication "A New Realm of Sources for Chinese Medical Historiography. The Chinese Medical Manuscripts of the 16th to the 20th Century in Two Collections in Berlin" (Budapest 2009): he reports that when, a few decades ago, he started to systematically collect the medical manuscripts he found in Chinese markets, these documents had no other value than that of being couched on a very soft paper, particularly prized as toilet paper, at a time when this kind of product was not easily available to the majority of Chinese. They are today very expensive objects, highly prized by collectors and historians. Being considered as a certain time as a product of current consumption, these documents have now reached the status of sources full of insights for a history of Chinese medicine.

[17] (De Certeau 1975, 84)

shown in several case studies in this book (Chu Pingyi, Christopher Minkowski), it is possible that the latter were influenced by the former in their ways of privileging and promoting some documents, but also that the former gave some documents specific consideration after they became aware of values that the latter had given them. Focusing on Asian documents thus presents the opportunity to bring to light various kinds of actors who acted on and sometimes interacted with the life of the documents.

Although the present volume focuses on the Asian world, it is not intended to cover all of Asia. The articles presented have been selected for the particular light they cast on the problem we wish to tackle. Indeed, in the time lapse between the production of a document and its use as a historical source, said document would go through many different processes in the hands of various actors whether we consider clay tablets made in the second or first millennium B.C.E. in Mesopotamia or Chinese, Vietnamese and Indian manuscripts of the eighteenth century. The variety of actors appears clearly, for instance in the case of Mesopotamia. As noted in the contributions of David Brown, Christine Proust and Philippe Clancier, clay tablets first had to be exhumed, by legal or illegal, scientific or amateur excavators, they had to reach museums and then be edited before becoming working material for the historian. Thus, the different potential sifts a document could be subjected to varies with the place, date, and materiality of the texts studied.

With these issues in mind, let us now give an overview of how the contributions in this volume offer a general approach to our questions.

The Organization of the Book

The present volume approaches the issue at stake from two perspectives. The first part focuses on different types of processes for selection, organization, and reorganization through which written documents of the past have come down to us and on the diverse actors in history who carried out these processes. Naturally the key question here is to determine the imprint these operations left on the historiography of science. In contrast, the second part gathers chapters in which, the authors, in order to shape their corpus and raise new questions in the history of science, take stock of the processes of selection and organization of scholarly documents that occurred in the past and skewed the historiography of science.

The first act of a historian engaging in research is twofold. On the one hand, he or she selects items from a set of documents that had formerly been assembled by specific actors, operating in specific places with their own distinct practices. The historian thereby isolates writings from the documentary context in which they have been made available to him or her. On the other hand, like other actors before him or her, the historian assembles the various items selected according to new processes of reasoning. This analysis explains why collections of documents in which the historian of

science finds his or her sources need, from our perspective, to be taken as objects of inquiry. We must highlight the choices that led to their constitution and address the issue of how these choices may be tacitly reproduced in the research work historians carry out on the basis of these collections. Moreover we must also understand how these various types of collections might bear the hallmark of processes of selection and organization of the earlier collections from which they derive. As will become clear below, by collection of sources, we not only mean libraries, archives, museums, or, to put it more loosely, documentary contexts, but also documents consisting of collections of bits of extant texts, such as compendia or encyclopedias. Thus the first chapters of this book are devoted to analyzing various kinds of collections linked to scholarly activities; each chapter focuses on specific and paradigmatic types of processes that could enter into the shaping of a collection as it can be approached today. With respect to the choice of focusing on science in Asia, these chapters allow us to cast light on two essentially distinct ways of collecting documents that need to be distinguished to account for the collections available to us today.

The first three chapters concentrate on the history of collections carried out by natives in Asia before modern times. Three paradigmatic cases—taken from Mesopotamia, China, and India respectively—are considered in these chapters; the difference between them lies in the manner in which the documents of the past have come down to us. The way in which the historian of science is able to consider the history of collections in his or her research work differs accordingly. In the case of Mesopotamia, it is only thanks to archaeology that the collections in which the historian finds his/her source material were brought to light. In contrast, historiography of science in India mainly draws on documents that were handed down through the written tradition and kept in libraries that were shaped and reshaped throughout history. As for China, after centuries during which the main access to the past was mediated by writings handed down from generation to generation and regularly collected by imperial institutions, the development of archaeology in the last century brought to light collections of sources of an entirely new type. These three articles focus on the practices and values of the actors who shaped collections in these different contexts, as far as we can restore them, as well as on the impact of these processes on the historiography of science.

In his chapter, devoted to ancient Mesopotamia during the first millennium B.C.E., Philippe Clancier shows that the selection and organization of tablets that shaped libraries was carried out in different ways, according to the kind of library—royal, temple, or private— considered. Assyriologists have commonly defined libraries as the collection of tablets pertaining to different fields of knowledge. However, Clancier's analysis of the content and disposition of tablets in different libraries exhumed in clear archaeological context discloses very different patterns of selection. Collections of tablets appear indeed to be very different, depending on whether they were made by/for kings, private families or people working in temples. Private libraries were commonly composed of texts or tablets pertaining to just one or two fields of knowledge,

while royal and temple collections were encyclopedic. Moreover, Clancier's contribution stresses that the material practices of the actors of the past played an important role in the differential preservation and promotion of Babylonian documents. For instance, while tablets were usually maintained by being systematically copied from generation to generation, some tablets, no longer being of use, were not. In the second part of the book, Brown analyzes the incorrect assumptions that some historians of astral science in Mesopotamia, failing to take into account the history of these processes of conservation, derived from the ensuing loss of certain types of tablets. Clancier gives another example of the importance of paying attention to the actors' changing material practices, which depended on the context in which they operated: while in some specific contexts, series of tablets were entirely copied, in others, such as a school context, only the first tablets of a series were copied. This remark not only provides a marker allowing us to identify a library as being related to a school context, it also shows that distinguishing between different collections and different modes of conservation can prevent us from formulating incorrect assumptions, for example explanations for the existence of incomplete series. These remarks show why it may be useful for historians to gather information about the material life of documents. The next case will cast light on another dimension, essential as well: the social life of documents.

In his paper devoted to Chinese sources, Donald Harper focuses on another kind of collection: compendia of texts, on the basis of which actors dealt with occult subjects— divination, astrology, hemerology, demonology, and the like. These collections have come down to us through two different kinds of channels. On one hand, numerous examples of manuscripts on occult subjects came to light thanks to archaeological excavations which have been carried out in China since the beginning of the twentieth century. These collections include manuscripts primarily excavated from fourth to first century B.C. tombs, as well as medieval manuscripts—primarily from the fifth to the tenth century A.D.—from a Buddhist cave in Dunhuang. On the other hand, other collections, like the *Summation of the five agents* (614), the *Yisi-year divination*, (602–670) and the *Divination classic of [the reign] Opened Epoch*, (ca. 714–724), were handed down through the textual tradition. The purpose of Harper's contribution is less to offer a new picture of occult knowledge in ancient and medieval China thanks to the analysis of these recently excavated documents than to analyze in a critical and comparative way the nature of documents and collections yielded by the two channels of transmission. The excavated documents testify to the fact that over the centuries occult knowledge was transmitted in writing in multiple copies of manuscript miscellanies, whose exact content was not fixed. By comparing the manuscripts with the transmitted compilations, Harper shows how different the texts they convey are, not only in content but also in shape. While the manuscripts of occult miscellanies, produced for personal use, appear unstable, without title or indication of classification, written on the verso of other famous texts, the compilations, which were commissioned by the state, offered "the

textual realization of an ordered world". In this process, Harper pinpoints how the editors in charge of these imperial compilations saw themselves as custodians of genuine knowledge when compiling their own works, "selecting the choicest booms and eliminating what was superfluous and false", "selecting those whose reasoning was proper and eliminating the others or placing them in a lower position". Such a comparison brings to light the fact that the documents handed down through the written tradition were precisely these highly selective compilations commissioned under imperial patronage; these documents were later regarded as master-piece or landmark texts in the historiography of occult knowledge. As a result, Harper's study discloses the part played by imperial institutions in promoting, circulating and thereby preserving certain kinds of documents. In contrast, the manuscripts provided by archaeology take us closer to the actors themselves and to the kind of collections of texts they used in their own practice of these fields. These various factors endowed the documents with different social lives, from which they did not survive equally. Note that, in this case, each of the two channels, which provided historians with sources, preserved a specific type of document: although the documents at one time all belonged to the same scholarly environment, they were separated through the process of transmission.

In the third chapter, Christopher Minkowski addresses early modern collections of Sanskrit scholarly manuscripts from the Indian sub-continent. Like Clancier, he concentrates on their variety: private versus state collections; collections shaped by bibliophiles as opposed to those formed by generations of families of specialists; princely state collections and colonial state collections. The different uses for which these collections were composed impacted the distinct principles ruling the selection in the various cases. For example, the collections shaped by the Vyas or the Toros were aimed at conforming to occupational practices. In the former case, the collection belonged to fifteen generations—covering four centuries—of a family of Gujarati astrologers, while in the latter, the collection belonged to Marathi performers of Vedic srauta rituals. In both cases these early modern collections bear witness to a wide circulation of ideas and manuscripts, while showing what little interest their owners had in other fields of Sanskrit lore. By contrast, the library accumulated by Anûpa, a Rajasthani bibliophile king in the eighteenth century, had an encyclopedic aim: he collected compendia in different fields—astronomy, law, and music—and commissioned new texts on these topics. The library could also serve as the basis for the preparation of scholarly works, in contrast to the former examples, where the documents gathered had an occupational function. The fact that Anûpa further prided himself on having "old and rare" documents in his library reveals the dimension of prestige involved in the making of the collection. In fact, the collection served state purposes, lending him authority over any matter discussed. "Age" and "rarity" were the very criteria that, in the late nineteenth century, reigned supreme over the manuscript collection campaigns carried out by pandits and sanskritists for British colonial libraries. Minkowski thus shows that there is no unbridgeable

discontinuity between the traditional and modern worlds. In both cases, values were likely to lead to extracting documents from contexts in which they had previously been used along with more common writings. The aim of the collection was what determined the kind of documents it included. As in Harper's case, Minkowski highlights the fact that the nature of the texts assembled depended on the nature of the collection itself. For example, the texts accumulated in private collections were not standardized: texts could be made of loosely grouped portions of different treatises and ephemeral data could be preserved. In contrast, ambitious state collections would systematically transmit standardized extensive texts. This conclusion shows clearly what the interpretation of a document can gain from determining the documentary context in which the document was collected and passed down.

The previous three chapters thus show how various types of native/indigenous actors of the past constituted collections that reflected—in the manner in which they selected and organized documents—their own practices and values. The last chapter by Minkowski introduces a new concern: how later actors, operating in a context where contacts between Asia and Europe had developed and intensified, relied on these early collections of scholarly documents to shape new collections. Indeed, the historian seldom has access to the collections composed by the actors on which he or she is working. These collections were regularly dismantled and their components reassembled, before finally entering the collections available to the historian. The study of the earlier collections appears therefore to be essential for us to understand the more recent ones in which the historians of science today find their sources. However, the latter collections also reflect new types of phenomena: they echo, in various ways, the global context in which, from the seventeenth century onwards, collections of Asian documents were formed. This global context introduced new dimensions into the activity of collecting scholarly texts of the past, dimensions that are essentially different from those examined so far. The following two chapters, which conclude the first part of the book, focus specifically on the new factors that shaped the collection of Asian scientific documents in pre-modern global contexts.

The case analyzed by Dhruv Raina focuses on European collections of Sanskrit documents, most specifically those related to mathematics and astronomy. One of the key points made in this chapter is to remind us of the fact that the first European approach to Indian knowledge in these fields did not rely on texts, whether in Sanskrit or any other language of the Indian subcontinent. Rather, French Jesuit missionaries acting in India wrote "proto-ethnographic" reports on the astronomical activities they could observe—mainly those of almanac producers—and for 50 years, European scholars viewed Indian astronomy primarily through the medium of these reports. By the end of the seventeenth century and the first quarter of the eighteenth century, there was a compelling demand for a view of India through Indian texts. It is in this context that the first European collection of Sanskrit documents was launched following the French King's orders and was to

form, between 1729 and 1735, a section of the *Bibliothèque du Roi*. We clearly see one of the effects of the global context on this new way of forming collections of Asian documents. How was the selection of documents made? The Jesuits in India were entrusted with the task of gathering and shipping them. The collection thus reflected their interests and their social networks. On one hand, it emphasized literary and philosophical works, granting little space to scientific knowledge. On the other hand, the very few astronomical documents it included were those used by the practitioners with whom the Jesuits were in contact, failing to incorporate the main scholarly writings to which these documents were referring. Despite its limitation in size and content, the collection was, together with the Jesuits' former ethnographic accounts, the only basis on which the first works on the history of astronomy in India—written in France at the end of the eighteenth century and of long lasting influence on subsequent historiography of science—could rely. We see how historiography depends on the collections available and reflects the factors at play in shaping them. The hypotheses formed in this context, that is, that Greek astronomy originated in India, stimulated British interest and reactions. This contributed to the formulation of a research program that led, in the nineteenth century, to much more systematic collecting of scientific manuscripts in India and to the publication of actual translations of the main astronomical and mathematical writings in Sanskrit, carried out by British indologists. With respect to mathematics and astronomy in India, the collections of writings assembled by the French Jesuits and British scholars differed sharply, providing contrasting views on scientific activity in India. In this example, we thus meet for the first time the key phenomenon that led us to concentrate on science in Asia to develop our critical analysis of the processes that shaped the sources of historians of science. First, the way in which these two types of European actors shaped their collections of Sanskrit scholarly documents exemplifies—when compared to Indian collections made in the Indian subcontinent—new purposes and new logic governing the circulation and regrouping of past documents. Second, as Raina shows, the various ways in which the British scholars and the French Jesuits combined the study of the Sanskrit writings with actual contacts with some of the "natives" to approach the knowledge of the "Other", demonstrate new uses for such collections, when compared to the uses made by the native scholars.

Chu Pingyi demonstrates, in his contribution, that even the collections of scholarly documents that were carried out in pre-modern times in Asia, that is, in his case, in China, reflected, in their conception, the awareness of a more global context. To make this point, he casts light on the processes that led, in late eighteenth century China, to the composition of the section on mathematics and astronomy in an imperially commissioned collection of books, the *Complete Library of the Four Treasuries* (*Siku quanshu*). This gigantic collection was to have a decisive influence on later historiography. Thus, bringing to light the factors at play in selecting and shaping works to be included in it, while rejecting others, is a decisive task for any critical analysis

of the historiography of mathematics and astronomy in China. Through this operation, documents that had once belonged in the same context became differentiated and were to have distinct futures. Chu Pingyi analyzes how Chinese scholars in the seventeenth and eighteenth centuries were confronted not only with astronomical and mathematical knowledge from the West, but also with its history compiled by the European Jesuit missionaries working for the Chinese imperial court from the mid seventeenth century onwards. He argues that, in reaction to this body of knowledge coined "Western", Chinese scholars attempted to revive traditional Chinese mathematical and calendrical methods by urging a search of ancient texts. Chu Pingyi shows how these voices later grew into efforts to compile and organize the astronomical and mathematical texts in the *Complete Library of the Four Treasuries*. This compilation was not a neutral collection of ancient texts. Chu Pingyi stresses how, to perform this task, Dai Zhen, the scholar in charge of this section, strove to restore ancient Chinese mathematical texts that were basically no longer available at that time for Chinese scholars. This restoration of ancient texts, spurred by the goal assigned to this section in the whole project, dramatically changed the documentary evidence on the basis of which one could inquire into the history of mathematics and astronomy in China, thereby marking a key turn in the historiography of science. Clearly, the way in which the compilation of the section in the *Complete Library of the Four Treasuries* was carried out reflected the encounter between European missionaries and Chinese scholars. Moreover, the compilation as such prompted a statement in reaction to it. As Chu Pingyi argues, Dai Zhen, by his selections, in fact equipped Chinese practitioners of astronomy and mathematics with a new textual arsenal comparable to the body of written knowledge produced by the Jesuits and their Chinese associates. The documents that were selected to be included in this prestigious collection, and the ways they were introduced to the readers by short notices, largely diluted the importance of Western astronomical and mathematical knowledge, turning it into one of the branches of Chinese knowledge. In brief, Chu Pingyi's contribution provides evidence as to how, in the Chinese world, both the emperors and the literati working for their editorial projects played a crucial role in the selection of documents of the past to be handed down and in the shape given to them.

In conclusion, the cases analyzed in the first part of the book indicate what may be at stake, for the historian of science, in the project of examining systematically the various types of collections of scholarly documents composed in the course of history—ancient versus the modern, the native versus those formed in a global context—and the different kinds of actors involved in the making of these documentary contexts along with their ambitions. The various chapters in part I highlight the impact of several types of factors involved in the making of collections of documents, that is, in the differential promotion, wider circulation and further preservation of these documents. These factors include cultural practices, strategies, logics and political agendas. As a result, we see how, against such a background, the

selective preservation of scholarly documents can be better understood, and their interpretation thereby improved. We will come back later to these points, but let us stress that, by these processes, some texts acquired the status of classics, or master pieces, whereas others that once belonged to the same work environment were, on the contrary, considered dispensable, or even undesirable. Some were over-exposed, while others were kept secret. It now appears clearly that upstream from the historians' act of composing a corpus and dealing with sources, a great variety of actors imposed their goals and values on the material and social life of documents.

On this basis, the second part of the volume turns to an issue that is essential to the whole endeavor embodied by this book: what can historians of science gain, if they pursue such a line of inquiry and develop an awareness of the processes at play in shaping the successive collections and documentary contexts through which the documents constituting their sources descended to the present day? In order to highlight the benefits that can be derived from such an approach, the second part of this book explores two main families of cases.

In the first one, the stress is placed on the fact that some collections of writings reflect the working environment in which some actors were operating. Despite the fact that the processes of transmission kept these collections assembled, in some cases historiography failed to consider them as such. In other cases, the documentary contexts in which the actors worked were dismantled by processes in the past that can be analyzed. For all these cases, the first chapters of this second part, aim to diagnose the reasons why the actors' collections and archives were disassembled. Moreover, they examine what is at stake for the historian of science in going upstream beyond these processes and reuniting documents that once belonged to the same work environment.

In contrast, in the second family of cases, the stress is placed on the fact that historiography relied on collections of documents that filtered out, in one way or another, whole blocks of the extant source material. Again, an analysis is provided to account for these processes of selection, and then the authors argue in favor of the importance of reintroducing into the historiography of science the documents once discarded in this way.

Let us concentrate on each of these sets of papers, respectively.

The first four chapters of this second part all deal with cases related to native/indigenous collections of the past. They all happen to have been treated as separate pieces by the historiography of science, whether they were dismantled by historians' treatment or by the historical circumstances of their preservation.

As for the collections which were shaped by the actors and treated as bits by historians, we chose to focus on an unquestionable and revealing case: in both ancient China and India, actors constructed collections of writings, which articulated with each other in several layers —a textual layer, treated as "classic," and one or several other layers of texts commenting on the former—which were handed down as such. As Karine Chemla and Agathe Keller show for mathematical collections of that type from ancient China and India, respectively, the actors used, and transmitted, the collections as such; this

is easily demonstrated by the fact that the layers do not materially exist in separate form. In spite of this evidence, historians of mathematics regularly either dealt with only part of the initial collection, or read the layers as texts independent from each other and succeeding each other in history. These two chapters discuss when, how, and why such treatments, which do not do justice to the collections as formed by the actors of the past, developed in the historiography of science. Here, treating the two cases in parallel helps cast light on the factors at play in the common attitudes manifested by historians of the past towards these kinds of collections. Furthermore, these chapters highlight what is at stake for the historiography of science, when considering the collections as they were once constituted or used by the actors.

Karine Chemla's article focuses on *The Nine Chapters on Mathematical procedures*, the first Chinese mathematical writing to have been handed down through the written tradition in China. It consists of a collection that brought together a "Canon" with commentaries composed respectively in the third and the seventh centuries. Chemla provides evidence of the fact that, from the seventh century onwards, the "Canon" and these two commentaries took the shape of an indivisible collection, the layers of which were always handed down together. Yet, she shows that in the last two centuries most historians did not exploit this collection as it was shaped and used by past actors. More precisely, Chemla argues that, since the nineteenth century, the "Canon", which is composed of seemingly concrete problems followed by procedures solving them, was at first the historians' main focus, while the commentaries were overlooked. She then shows in which circumstances the commentaries came more into focus. Yet, Chemla argues, at first, they were not dealt with *as* commentaries, but were rather treated as independent mathematical texts. At the same time, she notes that the historians who analyzed them mainly focused on their "results". In contrast, Chemla shows that if we treat the collection as it was shaped by the native actors, i.e. as composed of layers with the specific and distinct status of a "Canon" and "commentaries", this radically changes our understanding of *The Nine Chapters* and, more widely, of ancient mathematical practices in China.

Likewise, in Agathe Keller's contribution, the point is to interpret collections of various textual layers as such, since this approach provides evidence for the practices of the actors who shaped them. Keller centers on Sanskrit mathematical texts produced in India, that is, more specifically, on commentaries, written between the seventh and the twelfth centuries, quoting extensively the mathematical texts of the fifth to tenth century, which are those commented on. A first historiographical study allows her to highlight the reasons why historians gave some texts more attention than others. She shows that the disciplines to which the texts were believed to belong played a part in encouraging historians to deal with them or to leave them aside. Until recently, texts believed to belong to mathematics or astronomy were considered more carefully than those pertaining to astrology, as already indicated above for the case of Mesopotamia. Further, the *genre* to which the texts examined were

attached (theoretical or practical, treatises or commentaries) played a similar role. With respect to commentaries, a first hint indicates that they received different treatment from that granted to treatises. For example, in the nineteenth century theoretical astronomical treatises and other available mathematical texts (theoretical or practical) were fully translated for a European audience, commentaries were only partially translated and mentioned. Further, as Keller shows, although the Sanskrit manuscripts systematically contained commentaries extensively quoting the treatise commented upon, the European translations changed the relationship of the layers of text with respect to each other. The treatise became the main text, whereas the commentaries, partly translated, were broken down into pieces appearing in footnotes where they were grouped together. This echoes what Chemla has previously shown, that it was the Canons that first interested historians while they neglected their commentaries. In fact, Keller puts forward the hypothesis that nineteenth century historians were tacitly using commentaries in the way contemporary pandits did, i.e. by only reading portions of the commentaries and hence accordingly the portions of the text commented on. This practice is reflected in the material evidence: as shown by Minkowski, and as seen in Keller's study as well, specialized codices could contain copies of treatises and commentaries in bits and pieces. Keller further examines what is at stake in reading the collection of documents as provided by the actors who composed them by focusing on a specific topic, that is, the rule for extracting square roots. She argues that the historians who consider commentaries in relation to the treatise on which they comment are in the position of analyzing the reasoning underlying the mathematical algorithms, which is developed in the commentaries, but not in the text commented on. Moreover, and more generally, he or she can restore, within the context of mathematical writings, the practices of reading and composing treatises as well as commentaries. Again considering the collection made by the actors allows the historian to describe the scholarly practices which shaped them and to which they bear witness.

The following two articles examine cases in which the dismantling of the documentary context occurred prior to the historian's act of *mettre à part* (setting aside). Their main goal is to discuss what is changed for the historiography of science when one restores sets of documents that once belonged to the same working environment, but were taken apart, in this case, for reasons linked at least partly to the antiquity market and the constitution of Western collections, museums as well as private collections.

Christine Proust deals with the mathematical tablets used in houses of Nippur in which, four millennia ago, schools of scribes were located. She shows how, one century ago, the sharing—between Turkish and American archaeologists—of the tablets excavated from the site of Nippur led to the constitution, in Istanbul and Philadelphia respectively, of collections that reflected the different values prized by both sides as well as the power balance between them. Moreover, Proust emphasizes how the commercial circulation of documents from illegal excavations accounts for the dispersion of texts that had been produced and

used within the same walls. All these processes need to be taken into account in order to understand the way in which what once belonged to the same work environment became split into different collections. Bringing the separated pieces together is essential to restore a picture of the mathematical practices. Through this operation, Proust offers an interpretation of metrological tables—a type of source that has been neglected in previous publications—on the basis of practices attested to in tablets bearing witness to elementary education. Reuniting the tablets that had been dispersed in the various museums, that is, bringing together well-preserved and sophisticated tablets—those taken to the West—with the rough, fragmentary and less erudite ones—mainly kept in the Istanbul collection—, enables her to shed light on the curriculum of the scribe's education and the practices of calculation in Nippur. Restoring the set of tablets, as used in the past by scribes within the school framework, led her to a new interpretation of cuneiform mathematics.

Similar factors are at play in David Brown's chapter devoted to the tablets related to astral sciences in Mesopotamia. He notes how the different treatments tablets received from collectors and dealers led to a dispersion of the tablets that once belonged to the same working environment. Yet in this case, the historian has to take into account another factor in the subsequent treatment of the archives: once they had arrived in Western collections, the astral tablets, as mentioned previously, were more prone to be left aside in museum reserves than the tablets with mathematical or astronomical contents, which were overexposed and widely edited in relation to the concerns of historians of science. Brown argues that, in this case as in the previous one, it is essential to reunite the tablets that once belonged to the same documentary context. He shows how disregard for astral tablets led to incorrect assumptions not only in the history of cuneiform astronomy but also in the genealogy of Greek astronomy. In contrast, reconsidering cuneiform astrological tablets together with the other tablets with which they were once used allows him not only to understand cuneiform astral science better but also to trace its influences on the dominant—that is, overwhelmingly represented in our written evidence—part of Greek and Latin astronomy.

So far, this part of the book has shown why considering the collections and archives as they were shaped by the actors who used them as working environments allows the historian to restore practices and ideas attached to these working environments. However, the previous two chapters brought to light the fact that the historian is usually confronted with collections other than those made by the actors upon which he or she is focusing, collections gathered according to different logics. The last chapters of this part of the book focus precisely on this issue and examine what the historian may gain from setting aside collections made by actors different than those under examination and from considering the source material or the documentary context these collections hide. The organization of the four last chapters of the book which, consequently, mainly focus on pre-modern cases, follow a scheme similar to that of the four previous chapters. The first two articles present cases in which the collections that shaped present-day

historiography discarded whole blocks of evidence. Accordingly, this evidence was never addressed by historians of science and this raises the issue of determining what might be the benefit of reintroducing it to the field. The last two articles present cases in which the set of documents that shaped present-day historiography dismantled the documentary contexts used by the actors under consideration. They address the question of what benefit can be derived from reassembling documents that once belonged to a unique documentary context.

The contributions of Andréa Bréard and Florence Bretelle-Establet stress that the collections in which the historian finds his or her sources have often been shaped by actors who were not necessarily those who used these documents in their working environment. They were instead people who, striving to reconstruct the past or to impose a cultural order, had precise ideas about what a specific science should be. In the case addressed by Andréa Bréard, we see how, in China, different actors from the fourteenth century on strove to draw boundaries in the field of mathematical activities in order to demarcate a high and a low tradition. These boundaries drawn by various scholars were those that were used in collections of documents such as the *Siku quanshu* (*Complete Library of the Four Treasuries*) which brought together writings that reflected the scholarly practice of mathematics as a distinct endeavor and which, in turn, excluded from the section devoted to mathematics a great number of other writings. Bréard thus shows how the perception of a high tradition of mathematics played an essential role in the demarcation of what should fall within the corpus to be preserved in collections. This is, in turn, the reason why documents such as the *riyong leishu*—usually translated into "daily life encyclopedias"—that were widely circulated in China and Japan, from the sixteenth century on, were neither preserved in the *Siku quanshu* nor quoted in imperial bibliographies. They were not even preserved in modern Chinese libraries, and were mainly preserved in Japan. In correlation with the formation of a corpus of mathematical writings which met the criteria of a perceived high tradition, Bréard shows that other kinds of mathematical activities fell outside the scope of historiography—for example, mathematics practiced at leisure or activities in which the ethnographer recognizes a form of mathematical activity, even though it does not fall under the rubric of a contemporary understanding of the scope of mathematics. By reintroducing to historiography the daily-life encyclopedias that once were excluded from the prestigious collections, Bréard sheds light on the mathematical activities that were discarded by Chinese scholars and consequently, later, by modern historians. By focusing on different chapters of these encyclopedias—"Mathematical Methods" and "game of 'ivory tiles'"—Bréard documents mathematical activities which were conceived of as belonging to low mathematics and sheds light on a whole block of mathematical activities which were not addressed in any writing on the history of mathematics, because they were perceived as being outside the limits of mathematics. Reintroducing these documents into the historiography of mathematics thus allows her to sketch a new image of mathematical knowledge in

late Ming China and notably to argue that by the end of the sixteenth century combinatorial knowledge had already developed in China.

In the case addressed by Florence Bretelle-Establet, the stress is placed on the collections of medical writings commissioned by the Chinese State in the eighteenth century, a practice inscribed within a long tradition of imperial patronage of medicine. Since the beginning of the seventh century at least, medical books or compilations of medical prescriptions had regularly been commissioned by the emperors either to serve as textbooks in the Imperial Bureau of Medicine, the *Taiyi yuan,* or to be distributed throughout the whole empire to supplement the deficiencies of the central medical assistance. In the eighteenth century, the role played by the central power in the production of medical documents, and also in the circulation and promotion of certain texts and theories, was further enhanced. It took the form of three important imperial collections composed of medical writings produced from the Han dynasty up to the end of the eighteenth century. However, during the selection processes a number of medical writings were filtered out and this had a substantial influence on subsequent historiography. The analysis of the selection of texts produced in the late imperial period to fill these collections highlights that the emphasis was put on the medical texts written in one specific area, the Jiangnan, excluding medical writings produced outside this area. However, as this article stresses, geography, as usual, has a political meaning: the Jiangnan region was the most important economic center and was closer to the political center than any other region. The creation of these collections of writings that were thus biased towards texts produced in the richest and most powerful region had at least two consequences for the material and social life of the documents. First, texts did not have equal chances of survival nor equal chances of falling in the hands of modern historians. Second, such imperial compilations served to draw readers' attention to a selection of authors and, in this process, contributed to the historical promotion of some texts that were thus turned into texts of higher value, not only for the contemporaries of these imperial projects but also for later historians. Indeed, historiography of medicine in late imperial times generally relied on medical documents that were produced in Jiangnan and promoted in these imperial compilations. By reintroducing medical documents produced in the far south of China which had been left aside from the documentary contexts commissioned by the emperors, Bretelle-Establet not only sheds light on the medical practice and medical knowledge in one locality of the empire but by widening the historical research to social and geographical circles far from the center, her essay also gives elements of an answer to the broader issue of to what extent what happened in the powerful socio-economic centre of Jiangnan can be generalized to the rest of the empire.

These two chapters lay stress on whole blocks of evidence which for systematic and distinct reasons were not included in the collections of documents that shaped the historiography of science. The two chapters that conclude the second part of the book concentrate on another kind of case, one in which historiography has dismantled documentary contexts that were once

used by the actors. The example chosen to present this type of case is one in which despite the fact that documentary contexts brought together documents written in different languages, historiography has focused on those written in only one of these languages. As a result, the reasons why the documentary contexts contained distinct types of documents and the benefits historiography of science can derive from considering them together were two issues seldom addressed.

Catherine Jami focuses on the fate reserved for some scientific treatises written in Manchu at the imperial court in Beijing around 1700. Manchu, as Jami presents it, was the language of the founders of the dynasty which ruled China from 1644 to 1911. The creation of a Manchu language and a body of Manchu literature was an essential aspect of the definition of a "Manchu identity". It was a means for the new rulers to differentiate themselves from the population they controlled and to assert their cultural identity in reaction to the dominant Chinese culture. This body of literature thus included not only administrative documents and translations of a number of works from Chinese to introduce the young Manchu Bannermen to Chinese culture, it also included a number of treatises on topics as diverse as anatomy, musical harmonics and geometry written in Manchu by the Jesuit missionaries who tutored emperor Kangxi (r. 1662–1722) in "Western learning". Some of these treatises were eventually translated into Chinese and published. The documentary context shaped by the Manchu emperors thus contained both Chinese and Manchu archives. However, during most of the twentieth century, the historiography of China under the Qing (1644–1911) relied almost exclusively on sources in Chinese. Likewise the scientific treatises written in Manchu have long been left aside by historians of science who approached the issue of science and in particular that of scientific exchanges between China and Europe, relying only on European and Chinese sources. Jami stresses that different factors worked towards the marginalization of documents written in Manchu by historians. One reason was ignorance of the Manchu language in the twentieth century. Manchu was progressively replaced by Chinese, and by the eighteenth century it had mainly become an administrative language, before falling into oblivion after the downfall of the Manchu rule. Another reason was the Chinese nationalistic and anti-Manchu feelings that dominated the political scene after the foundation of the Republic of China in 1912. But Jami also stresses that Manchu might have been used by the rulers themselves as a kind of secret code to restrict the circulation of information. Evidence attests that some documents written in Manchu were not translated into Chinese on imperial order. Thus, reintroducing these documents into the picture of imperial science retrieves the complexity of the circulation of learning within the Chinese world. Moreover, it allows understanding how knowledge was constructed through the very process of circulation which, in fact, involved more entities and actors than previously assumed by a historiography that had only relied on Chinese and European sources.

In the last contribution to this book, Michele Thompson also addresses the issue of the different fates reserved in historiography for medical writings of

Vietnam, depending on the language in which they were couched. Catalogues of sources, she notes, attest to the fact that medical writings in Vietnam were either written in Chinese, in *Nôm* or in a combination of these two languages. In spite of a documentary context that thus brought together writings in different languages, the historiography of Vietnamese medicine has primarily focused on the medical writings in Chinese. Thompson identifies the various actors and processes that led to the marginalization of *Nôm* writings in historiography. Two kinds of actors came into play in this process that took place during the nineteenth century: native actors and foreign observers. By prohibiting in 1820 the use of *Nôm* in all court documents and shortly thereafter in the royal and provincial level examinations, Emperor Minh Mạng of the Nguyễn dynasty placed emphasis on Chinese as never before. In this process, *Nôm* was granted a lower position, especially since it was also the language used for translating catholic texts. As such, in the eyes of the emperor, it concentrated the features of an unofficial and subversive language. The emphasis on texts written in Chinese was thus partly the result of a native policy in nineteenth century Vietnam. It was however enhanced by the French, who, in their attempts to decipher the history of Vietnam first focused on its political aspects and therefore on the documents written in the administrative language of Vietnam, that is Chinese. Native actors and foreign observers thus placed an emphasis on texts written in Chinese while marginalizing *Nôm* writings. Thompson analyses how setting aside medical texts written in *Nôm* led to the general agreement that Vietnamese medicine had acquired most if not all of its theoretical underpinnings and many of its therapeutic practices from Chinese medicine. She goes on to discuss the implications of reintroducing the medical sources written in *Nôm* into historiography, inviting us to see how these texts actually reflect a substratum of Vietnamese medical knowledge and traditions that continued to thrive and evolve under an overlay of Chinese importations.

This long and sinuous walk between different periods, geographical areas, and fields of scientific knowledge allowed us to identify different kinds of actors who, apart from the historian and before he or she sets out to work, intervened in different ways in the life of documents of the past. Let us now gather our various threads and consider some of the most important points highlighted by these case-studies. They converge to provide the first elements of an answer to the question raised in the beginning of this introduction.

The Material and Social Life of Documents and Their Impact on the Historiography of Science in Asia

The question of the unequal use of documents in the historiography of science in Asia led us to take as object of inquiry collections of texts or, more precisely, documentary contexts in which the historian finds her/his sources. This set of case-studies first clearly highlights that the unequal survival of written documents

of the past is not solely due to accident or design. Time undoubtedly does account for the unequal survival of sources. Ancient sources, particularly, because of the differences between the material medium on which they were recorded, were affected by time to various degrees. As Clancier underlines, Mesopotamian clay tablets enjoyed more longevity than wax tablets (tablets made of wood covered with a layer of wax) or parchment documents, only because the material they were made of differs. However, other systematic factors contributed to the diverse life span of tablets: for example, the fact that as early as the end of the second millenium B.C.E. part of the tablets were regularly copied by generations of scholars while others were not. Therefore, and this is the second and most important point brought to light by the contributions gathered in this volume, beyond the factor of time, various actors intervened in the material and social life of the documents, through different operations, granting them thereby different fates in history and historiography.

Each of the chapters in this book brings to the fore different kinds of these actors. Native rulers and native elites who controlled the production of documents and cultural life left their mark on the way in which Asian documents were preserved in an unequal way. The cases dealt with showed that one had also to take into account foreign actors as varied as missionaries, colonial rulers, and archeologists mandated by Western museums. They were all key actors who, through different kinds of processes, contributed to giving Asian historical documents very different lives. In addition, the various contributions allowed us to identify two main types of processes that had important consequences for the life of documents produced in the past.

Harper, Jami and Thompson all brought to light phenomena of prohibition or censorship that heavily affected the life of documents. Ordering the destruction of documents in Chinese history was not limited to the reign of Qin Shi Huangdi (221–207 BCE). Harper recalls that by the early seventh century, several rulers in China, had issued decrees that prohibited the circulation and ordered the destruction of existing copies of some of the manuscripts dealing with what Harper refers to as "occult" knowledge. If those manuscripts did not totally disappear, they did not survive in the written tradition. Evidence of their existence was brought to light in the twentieth century thanks to archaeological excavations and, in this case, we can see how such filters would have had an even greater impact on historiography if we had not had access to other sources of documentation. If prohibition did not lead to the complete destruction of writings in all circumstances, it, however, contributed to granting documents unequal status. This is also the case with some of the books dealing with science and philosophy written by the Jesuits and their Chinese associates in seventeenth century China. As Jami recounts it, Kangxi, the second emperor of the last dynasty that ruled over China, had ordered that books written by the Jesuits and their Chinese associates in science be first translated into Manchu, his native language, before being translated into Chinese. This would allow him to judge if it was appropriate to widely circulate them throughout the empire. He decided that a number of these items should not be translated. They were therefore not

translated into Chinese and were instead kept secret in the imperial archives. As a result, historians did not have access to them for a long time. The prohibition, discussed by Thompson, of the use of the *Nôm* script in all court documents and in the royal and provincial level examinations, as decided by Emperor Minh Mạng (r. 1820–1840) in 1820, created in Vietnam a Chinese language policy. This, in turn, contributed to granting Vietnamese medical literature written in *Nôm* a particularly low status with a somewhat seditious tone in comparison with the medical literature written in Chinese. This difference of status left a long lasting impact on historiography.

If prohibition or censorship is the process that most clearly affected the life of the documents of the past, the opposite practice of collecting texts was also a type of manipulation that had consequences for the life of documents. Contributions in this book show how collections of written texts are never neutral gatherings of documents. The selection and organization of documents in each collection reflect the practices, the values, and the ambitions of those who shaped them. The reader will see specifically as she/he progresses through this book how these practice might have responded to various purposes. If the collections of the Toros and the Vyas or the collection of Sīn-leqe-unnini respectively discussed by Minkowski and Clancier were shaped in order to maintain the social position of a family, the gigantic collections commissioned by Anupa and Qianlong, respectively discussed by Minkowski and Chu Pingyi, served another purpose: to legitimate the rulers' authority and to confirm their position as patrons of intellectuals. Qianlong's collection, however, along with the different Chinese imperial collections described by Harper, answered another need: to transmit controlled and filtered knowledge. In contrast, the Mesopotamian royal libraries, discussed by Clancier, in addition to securing the patrimonial preservation of the works of the Sumero-Akkadian culture, were expected to protect the collector from malicious influences. If European collections of Asian documents sometimes shared some of the native collectors' ideals such as securing old and rare texts, they usually also responded to other targets. The Jesuit collection of Indian manuscripts or the collections in British colonial libraries respectively discussed by Raina and Minkowski were shaped in order to document the Other. The collections made by Western museums discussed by Proust and Brown were formed to glorify national richness. According to these different aims, the diverse milieus that constituted these collections drew boundaries to delimit documents worthy of preservation and exclude those deemed unworthy. Documents were selected to be gathered and preserved in one collection, sometimes in deep secret, because of their intellectual content and social usefulness (Minkowksi), because of their relevance to the superiority claims of science (Chu Pingyi), for their aesthetic quality and value as merchandise (Proust, Brown), and for their performative function (Clancier). At the same time, because they were not relevant in regard to the criteria defined by the collection makers, others were left aside, abandoned and sometimes even destroyed. This is the case for tablets of poor appearance (Proust), documents of short-term relevance (Brown, Bréard), practical material that was made "ready-to-hand" (Minkowski) and documents

produced outside the milieus which had the power to define and maintain a cultural order (Bretelle-Establet, Bréard). The contributions gathered in this volume thus clearly show that collections of texts are always a set of specific choices. Besides the original choices that might have ruled a collection, let us add that once the collection was shaped, documents thus gathered were thereafter the object of different archival practices, which involved discarding certain texts that were no longer in use, or copying older texts before they disintegrated. As mentioned earlier, not all the Mesopotamian tablets were copied regularly: it was mainly the so-called canonical texts—epics, hymns, divinatory series, medical series, rituals—that were regularly copied while mathematical, astronomical, historical texts and school tablets were very rarely copied.

Documents are not dead objects, once they are produced they enjoy various material and social lives. This is shown in the different contributions of this book through an emphasis on two phenomena: first, destruction and marginalization due to censorship and prohibition, and second, the differential promotion and preservation of documents due to collection practices. The cases addressed in these contributions pinpoint the fact that upstream from the historian's first act of shaping a corpus, according to his/her time-dependent historical questions and agenda, some documents were deliberately destroyed, others because they were not regularly copied just disappeared, still others, because they were highly praised for cultural content that would secure their collectors social success or because they might have caused too much trouble to an established cultural order were kept secret and away from public access. Further, some documents were granted specific status—classical texts, landmark texts—while others acquired the status of marginal or accessory documents. Some coherent series or consistent sets of documents were artificially separated whereas documents that did not necessarily belong in the same working environment might have been gathered and promoted as a consistent set of texts.

In each case, the contributions in this volume also illustrate how such processes had an impact on historiography as well. As illustrated by the different cases dealt with in this volume, historiography sometimes repeated the manipulations of the actors of the past, by either focusing on the documents that in the past, and through the above mentioned manipulations, had been granted dominant status or by leaving apart the documents that had been either neglected or hidden from the public in the past. In F. Bretelle-Establet's essay it is shown that in spite of the proliferation of medical texts all over the Chinese territory in late imperial China, historians have mainly focused on medical texts that had been granted the status of essential medical documents by native elites who had the power to impose and maintain a certain cultural order, notably through the selection of valuable texts to be included in imperial collections such as the *Complete Library of the Four Treasuries*. In the field of history of mathematics in late imperial China, the documents, which were praised by the native elites in official collections and were perceived by them as belonging to a high tradition, were the main focus, in spite of the fact that many other texts that bore witness to mathematical activities and knowledge circulated widely from the sixteenth century on. As Bréard notes,

it was not the canonical mathematical text—the *Nine Chapters*—that the Jesuits in the late seventeenth century brought to Paris, but the widely disseminated *Unified lineage of Mathematical Methods* compiled by Cheng Dawei (1592) that had been excluded from the prestigious imperial collections. Historiography of medicine in Vietnam also illustrates how in spite of a huge number of medical texts written in *Nôm*, historians have, until recently, mainly focused on the medical texts written in Chinese, the language that in the beginning of the nineteenth century, had become the authorized written language in Vietnam while *Nôm* was forbidden in official documents. Likewise, in their contribution, Minkowski and Jami also address the fact that contemporary historians did not consider the documents which were deliberately left aside by the actors of the past for different purposes. Minkowski notes that the heads of the Jaina monasteries and temples were very reluctant to show their materials to nineteenth century collectors. Thus their religious texts were much less well known in the academic world, despite their cultural importance, and they have been subject to much less serious study in modern research. And it is not an accident if, in the historiography of science in Qing China, the documents which were written in Manchu and not translated into Chinese according to Kangxi's desiderata, did not reach the foreground of historiography, which mainly centered on texts written in Chinese and hence on authorized documents.

The contributions thus gathered in this book not only bring to light some of the actors and processes that might have intervened in the lives of documents of the past, they also show that if the historian were to neglect the various operations carried out in the past, by a great variety of actors, on the material and social life of documents, he/she would run at least two risks. First, if the historian were to shape her/his corpus on the basis of a collection of documents without an awareness of all the processes of selection, organization, and preservation that had previously occured, he/she would run the risk of espousing the views of the various actors who before him/her had selected documents according to their own values, logic, and ambitions. Second, if the historian were to work on various components of a set of documents that was used as a whole by actors in their working environment but came to be dismantled by successive collection makers, he/she would run the risk of misinterpreting the isolated fragments. In both cases, he/she would lose the sense of the scientific activities that took place and developed in those environments.

Would it make a difference to historiography of science in Asia if historians were to take stock of all the processes imprinted on the documents of the past by the various actors who affected them? Would our knowledge of science in Asia change? The book constitutes an answer to these questions: it gathers results and opens areas of research. The critical analysis of sources it developed did not limit itself to providing a simple reflexive exercise that would have aimed merely at improving our use of archives and other documents of the past. By reconstructing the set of documents that were once built by the actors who used them in their working environment, or by going beyond the prohibitions, the emphasis, or the selections made by various actors in history, the contributions gathered in this

book give new results and raise new questions in the field of the history of science in Asia. As the reader will discover in the following pages, they reveal the importance and the specificity of reasoning where one had seen before only procedural and practical operations; they disclose a richer and more complex picture of scientific interactions between the West and China and between China and Vietnam; they shed light on new paths of circulation of knowledge between different areas and milieus; they point out relations between different fields of knowledge and between different "civilizations" that had, until now, been conceived of as sealed; they allow reconstructing the curricula of elites and the landscape of calculation practices in well identified milieus as well as allowing better understanding of the uses of mathematical knowledge in relation to the social and material contexts in which it was produced.

These are only partial results. They are however promising and invite us to consider whether such a critical analysis of the documents that have become our sources could be fruitfully extended to other fields of knowledge and further to the "non-Asian" world!

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Part I
Collecting Documents: Which Impact on the Material and Social Life of Documents and on Historiography?

Formation and Administration of the Collections of Literary and Scholarly Tablets in First Millennium Babylonia

Philippe Clancier

Introduction

Mesopotamia of the first millennium B.C. was divided into Babylonia in the south of present-day Iraq and Assyria in the region of nowadays Mosul. Babylonia and Assyria both formed part of the Sumero-Akkadian culture which combined elements of the Sumerian and Akkadian traditions; these traditions were conveyed by the cuneiform writing system. The latter was developed in lower Mesopotamia—i.e. during the second half of the fourth millennium B.C. in the south of present-day Baghdad—and was used until at least the second century AD.[1]

The epigraphic sources consist of mud—or backed—tablets that were preserved in the Mesopotamian soil; these sources were discovered during archaeological excavations conducted with varying degrees of rigor. Thus, some collections were unearthed during scientific excavations that carefully registered all the elements allowing us to reconstruct today their context. Such excavations permit—and in particular with respect to the libraries, the case of interest to us here—to get a quite precise knowledge of their arrangement, material organisation, classification and to give an idea of the limits to their text categories. The collections, which have been excavated and reconstructed in this way, allow us today not only to establish a typology of the libraries, but also to study the manner in which they were built and their purpose. Unfortunately the archaeological data have not always been rigorously recorded, far from it. In the nineteenth century a great number of libraries were discovered either by clandestine excavators or by archaeologists officially appointed by an institution at times when excavation techniques were only in their early stages.

[1] (Geller 1997, ZA 2007)

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F. Bretelle-Establet (ed.), *Looking at It from Asia: The Processes that Shaped the Sources of History of Science*, Boston Studies in the Philosophy of Science 265,
DOI 10.1007/978-90-481-3676-6_1,

Two big collections are concerned: the royal library of Nineveh, the Assyrian capital, most often named 'the library of Aššurbanipal' and the library of the Esagil, the temple of the god of the city of Babylon, Bēl-Marduk i.e. the main library of the town.

Further, the epigraphic sources of first millennium Mesopotamia are unevenly spread over space and time. The reasons for this are historical and archaeological. First, until 609 B.C. Babylonia and Assyria interacted with each other, sometimes bellicosely. In 609 Assyria was conquered by the Mede and Babylonian allied armies and Assyria as such disappeared. The extent of the destruction of the Assyrian towns was so important that for a long time thereafter they were left in a state of neglect. The consequence was that cuneiform writing ceased to be used in the North. Thus, starting from the end of the seventh century, Babylonia remained the only place that continued to use the Mesopotamian cuneiform script[2] and hence this is where the libraries were found; these libraries enable us to document the entire first millennium B.C. Further the lots of archives and the libraries of clay tablets were discovered in specific places on each site, most often in small rooms. However, these finds are often due to chance; therefore it is necessary to be cautious from a methodological standpoint, since our reasoning is based here on incomplete documentation.

And yet, a number of libraries and archives have been discovered in Mesopotamia. They have revealed thousands of tablets, many of which have been found in clear archaeological contexts. This study focuses more specifically on Babylonia since the latest and most significant advances concern this region. The richness and variety of the corpuses found in this area permit to establish a typology of the collections of documents that will serve as a general framework for this investigation. Three main categories of collections of documents can be clearly distinguished:

The first of these categories will be named here archive. This term designates the collections that the scribes set up and organised with a view to preserve texts relating to the every day life of a family or an institution i.e. legal documents (for example, contracts), administrative texts, correspondence etc.[3] The second category can be called either collection of manuscripts or collection of archives. These are mixed collections made up of tablets relating to every day life on the one hand and literary and scholarly tablets on the other.[4] Lastly, the libraries themselves, on which this article focuses. They are composed of literary and scholarly tablets. How were these collections set up? Who were the scholars who produced and gathered these

[2] Except for Urartu, a state that was situated between lake Van and lake Urmia; this state disappeared at the beginning of the sixth century. Further, the Achaemenids also developed a cuneiform script to record the ancient Persian language.

[3] Concerning the definition of archive, cf. (Jursa 2005, 4–6).

[4] (Charpin 1986, 430–1).

documents in the first millennium? In what intellectual and institutional context were these collections put together? What functions and uses were these collections of sources—and knowledge—intended for? What are the scholarly practices that might reflect their profile?

In the first section, the historian's definition of a library will be given considering content and organisation. In the second section, I shall establish a typology of the libraries on the basis of different criteria of analysis: the categories of texts, the different institutions and the arrangement of the tablets. Finally, a third section will consider the modes of preservation and the arrangement of the tablets.

Libraries in the First Millennium B.C.

Several sources shed light on the Mesopotamian scholars and their erudite activities. These sources are composed of the scholars written documents, for instance their correspondence and creations. However, it is the large collections of literary and scholarly tablets, which were gathered, classified and stored in specific places—we call libraries—that give the best account of the extent of their work.

The Establishment of Reference Works and the Emergence of Libraries

The Mesopotamian scholarly tradition of the first millennium is the fruit of several centuries work, not to say several millennia. Basing our reflection on an impression of conservatism or slow development, one might be tempted to consider the second and first millennia as periods of permanence. And yet, although there were undoubtedly many factors of continuity between the two periods, the canonization of the scholarly texts at the end of the second millennium led to significant changes in the ways of preserving, transmitting and consulting the ancient tradition.[5]

At the end of the second millennium and the beginning of the first, the great scholars —the *ummânu*—created works of reference in all the erudite domains of the time.[6] In order to do this they determined which texts should be kept or

[5] The purpose of the following lines is to differentiate the uses of the second millennium from the ones of the first millennium discussed here. Regarding the second millennium, cf. the contribution of C. Proust in this volume.

[6] Concerning these domains, cf. *infra*.

not among the large number of documents relating to a common subject and also considered the manners in which the texts could be put together. This phenomenon cannot be precisely dated since the works that can be considered ‘authoritative’ appear at this time in their almost ultimate form.[7] However this development profoundly marked the Assyrian and Babylonian scholars themselves; in particular, this can be seen by the preservation of the names of some of the authors of these reference texts. Sin-leqe-unnini, is the best known of these authors. The canonical version of the epic of Gilgamesh, of which the numerous traditions can be traced back to the third millennium,[8] has been attributed to him. Others are known such as Esagil-kin-apli, the compiler of the series of clinical diagnoses (sa.gig) and whose work is also the source of the second part of the *exorcist's handbook,* a list of texts and knowledge that the exorcist-doctors had to know. The list is important and was not lost during the first millennium; on the contrary it was carefully maintained as can be seen from an exceptional document, the *List of the apkallu and ummânu*.[9] The latter is an artificial list of scholars that helped the kings of the country throughout all periods. The list covers the entire historical period going back to the times of the primordial sages, the *apkallu*, which were sent by the gods to educate the first men.

It seems that the establishment of a reference corpus was one of the bases of the creation of libraries. The libraries only appear as such at the end of the second millennium. They were composed of canonical works. Other documents—that we shall come back to—also became part of these libraries.

The Library: A Problematic Definition

Assyriologists agree that the libraries consist of collections of literary and scholarly tablets, i.e. documents that belong to the following major thematic categories: omens (all the documents related to astrological divination, terrestrial divination, teratomancy, oneiromancy etc.); texts of exorcism and medicine; religious texts (songs, hymns, religious rituals etc.); technical texts or factual texts (history, topography, astronomy, mathematics etc.); literature (epics, myths, lamentations, texts of wisdom etc.) and the lists and school

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[7] It should be noted that the works were transmitted by means of successive copies, thus more or less important variations occur on the tablets throughout the first millennium due to scribal errors, new interpretations in the form of glosses etc. A good example of the effect of the copying on works that became canonical works is considered by J. Bottéro in his analysis of the *Manuel de l'exorciste* (Bottéro 1996, 65–112).

[8] Concerning Sin-leqe-unnini and his descendents, cf. (Beaulieu 2000).

[9] (Van Dijk, Mayer 1980 (*BaM*, 089)).

texts.[10] However such categories are modern ones, furthermore a document may belong to many of these categories at the same time. Thus, the *Enūma eliš* (the Epic of Creation) belongs at the same time to the category of literary texts and to the one of religious texts; and considering that it gives a commentary of the fifty names of Bēl-Marduk, the patronal god of the city of Babylon, it can even be partly considered as lexical.

From a different standpoint, M. Weitemeyer had identified three criteria to define a library: the existence of serial classification according to subject, the existence of colophons used in particular for the above mentioned classification and the existence of catalogues.[11] In the case of the Babylonian libraries the first two criteria are very often satisfied, as for catalogues, they are not attested.[12]

Scholars in Babylonia

The establishment of libraries was the work of the scholars. By this term we mean people able to read, write and make commentaries of the major literary and erudite works that were canonized at the end of the second millennium or at the beginning of the first. These scholars most often claimed to come from an important scribal family and to be the descendent of an erudite ancestor. The word 'expert', *ummânu* in Akkadian, is the term the scribes usually used to name themselves. In the first millennium, most of these scholars are linked, in some way or another, to the temples, even if some of them have become courtiers. The major scholarly disciplines of Mesopotamia in the first millennium correspond to the main fields of scholarship and are therefore chiefly represented by the following professions, at least as regards Babylonia: the astrologists (*tupšar Enūma Anu Enlil*), one of whose activities was the collection of information relating to the aspects of the sky; the haruspices (*bārû*) that performed divination by reading animals' entrails. This speciality practically disappeared in the second part of the first millennium, supplanted by astrology. However it remains well attested in the Ebabbar, the temple of Šamaš—the sun-god—in Sippar at the beginning of the fifth century and also in the Esagil of Babylon thereafter.[13] The exorcists (*āšipu*) had to protect the living from

[10] This thematic division is inspired by the one adopted by (Wiseman and Black 1996, 4 and 9–36).

[11] (Weitemeyer 1956).

[12] There are the 'catalogues' of the wax tablets of the library of Aššurbanipal in Nineveh, but these resemble more inventories than a classification device. Catalogues and lists of works should not be confused either, see for example the *Manuel de l'exorciste* (Bottéro 1996, 65–112).

[13] (Boiy 2004, 273).

supernatural dangers and to heal the souls and bodies. At the end of the period, it is difficult to distinguish them from the *asû*, the latter appear to have been more specifically specialized in the treatment of the body. And finally the lamentation-priests (*kalû*) that formed a particular body whose office was to sing and declaim texts during the religious ceremonies. They also appear to have been in charge of the establishment of the religious calendars, in particular in Uruk and Babylon.[14]

The generalist training of the scholars allowed numerous exchanges between the different specialists. This is how Marduk-šapik-zeri, one of these scholars, presented his skills to the Assyrian king:

> [36]I fully master my father's profession, [37]the discipline of lamentation. I have studied and [38]chanted the Series. [39]I am competent in [. . .], 'mouth-washing', and 'purification of the palace' [. . .]. I have examined healthy and sick flesh. [40]I have read the (astrological omen series) *Enūma-Anu-Enlil* [. . .] and made astronomical observations. I have read the (anomaly series) *Šumma-izbu*, the (physiognomical works) [*Kataduqqû*, *Alandi]mmû*, *Nigdimdimmû*, [. . .and the (terrestrial omen series) *Šumma-ālu-i*]*na-mēlî-šakin*. (. . .)[15]

Thus an accomplished scholar, an *ummânu*,[16] fully mastered a discipline. In this case, it is the art of lamentation (*kalûtu*). But he also had to have a good knowledge in the other fields of erudite knowledge: haruspicy, astrology, teratomancy, omens of everyday life etc. This generalist training is echoed by Aššurbanipal—king of Assyria from 668 to 627—who had himself received a solid education:

> I have studied the technique of the sage Adapa, the hidden secret tradition, all the disciplines of the scribe. I am experienced in the terrestrial and celestial ominous signs; I discuss them in the assembly of the experts (*ummânu*). I debate (the work) *If the liver is a reflection of the sky* with expert diviners. I can solve the most complex reciprocals and products that do not have a solution. I have read a sophisticated composition, whose Sumerian version is obscure and whose Akkadian version is difficult to interpret. I have examined rock inscriptions from before the Flood.[17]

These activities determine the physiognomy of the libraries that were found in the palaces, temples and private houses.

The Institutions That Housed the Libraries

Three major types of libraries, which were linked to different institutions, coexisted:

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[14] There are other types of priests in charge of the temples, but only the most important professions regarding the scholarly practices will be considered here.

[15] (Parpola 1993, 122).

[16] This is the term used by Marduk-šapik-zeri in line 35 on the reverse of the tablet (Parpola 1993, 124).

[17] The translation of the tablet K 3050 + K 2694 is based on P. Villard's translation (Villard 1997, 137).

1. Palace libraries. To date they are attested in Assyria. It is possible that the temple library of the Esagil in Babylon also fulfilled the function of royal library.
2. Temple libraries. They include on the one hand the library owned by the god—i.e. part of his property—that could cover several rooms, of which some might have been specialized (such as the astronomical data texts stored in the Esagil and the Bīt Rēš seem to suggest); and on the other hand the working library which was related to a definite profession. The latter can be illustrated by two clear examples: the library of the lamentation-priests of the Bīt Rēš of Uruk and the one of the haruspices of the Ebabbar of Sippar.
3. The private libraries. They include on the one hand the libraries containing collections that were principally either intended for instruction or were the result of teaching activities, and on the other hand the scholarly libraries that can be distinguished from the former by the small number of school texts they contain and the presence of complete and varied series of texts on their shelves. For instance such a collection is illustrated by the Neo-Assyrian library of Kiir-Aššur and the letters of the Assyrian kings asking for specific tablets from private collections to supply their personal collection.

The palace and temple libraries both show an encyclopaedic profile i.e. grouping together all the canonical cuneiform works and series such as they were fixed at the end of the second—or during the first—millennium.[18] The palace libraries are only documented in Assyria, in particular in Nineveh, the last major capital of the empire. Collections of literary and scholarly tablets were found in temples both in Assyria and Babylonia; these collections shed light on the entire first millennium. In Assyria, let us mention the library of Nabu—the god of scribes—in Kalhu, modern Nimrud.[19] In Babylonia, the best archaeologically documented collection was found in the Ebabbar, the temple of Šamaš in Sippar. And although the Bīt Rēš, the great temple of Anu in Uruk,[20] has provided a fair number of texts, above all it was the Esagil, the temple of Bēl-Marduk in Babylon, that seems to have housed the biggest library in southern ancient Iraq.[21] The temple libraries were used as reference collections by the scholars who visited them in order to find and possibly copy the texts they needed.

The libraries recovered in private houses are not encyclopaedic, on the contrary they focus on one or several disciplines. The clearest cases are the

[18] For Oppenheim, the function of the palace libraries of Nineveh was to provide the king and his counselors with the texts that allow understanding the will of the gods with respect to the king. We shall consider this below.

[19] (Wiseman and Black 1996).

[20] (Pedersén 1998, 209–10).

[21] (Clancier 2009a, 105–213). There are other important collections such as the library of the Ezida, the temple of Nabū in Borsippa, whose reconstruction is not yet finished.

ones of the libraries of the exorcists of Uruk, discovered in excavation square Ue XVIII in the south-east of the city. The typological analysis of the texts of these collections gives us an idea of the reasons and conditions of their formation.

Let us also mention another type of specialized library which was found above all in the temples: the professional collections. This type is very well documented by the library of the temple lamentation-priests in Uruk during the Hellenistic period. This collection of literary and scholarly tablets includes in its vast majority documents relating to the professional practices of the lamention-priests of the temple.[22] Insofar as this profession was integrated into the family patrimony by the descendents of Sin-leqe-unninni, it was thought for a time that this was a private collection kept in the temple. It is likely that at the end of the sixth century the library of the Ebabbar in Sippar also consisted of two separate collections: a mixed collection of scholarly and legal texts discovered by H. Rassam—the archaeologist of the site between 1879 and 1882 commissioned by the British Museum—and a collection of professional content—discovered in the eighties—belonging to the diviners of the temple.[23] Considering the private libraries, it can be difficult to determine the exact nature of the collection: is it designed for teaching or is it the reflection of the profession of its owner? This is particularly true for the libraries that were discovered in Assyria.

It is complex to establish a typology of the libraries. Indeed, each institution (family, palace or temple) may house collections set up for different purposes. This is particularly true in the private sphere where scholars might have set up collections of tablets for various reasons: personal professional practice, instruction or scholarship. In the following, this typology will be examined from every angle in order to shed light on the relations that existed between the institutions, the professions, the erudite disciplines and the modes of collection preservation and renewal.

The Purpose of the Collections

The varied content of the libraries and their place of discovery enable us to understand the purpose of the collections: teaching; the collection of documents relating to a particular profession and encyclopaedic knowledge.

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[22] The tablets were published – in the form of hand-copies of the tablets - by (Van Dijk, Mayer 1980).

[23] See (al-Jadir 1987) for a rapid introduction to this discovery.

Teaching

Teaching is documented in all periods by lexical, literary and mathematical school tablets organized—or not—in the form of a library.[24] Concerning the first millennium two major corpuses permit to consider the student's curriculum: the tablets discovered in the temple of Nabu *ša Harê*[25] in Babylon and those of the private libraries of Uruk. In the first case, the collection consists of tablets offered to Nabu, the god of scribes, by his students—whatever their level—and does not constitute a library; it is a votive deposit intended to be used exclusively by the god. Thus, it will not be considered here.

Therefore the private libraries of Achaemenid and Hellenistic Uruk offer the best example of educational collections in a domestic context. A study of the exercises shows that teaching was made at two different levels in the first millennium: an elementary level—partly taught in the temples—that consisted in learning to read, write and calculate; an advanced level—taught in the domestic framework—that permitted to acquire the necessary erudition for a future profession and the status of scholar.[26] The exorcists' libraries discovered in Uruk are the reflection of the latter. These libraries were discovered in the south-western part of the site of Uruk and were altogether composed of 419 literary and scholarly tablets.[27] They were preserved in a house that was in the possession of exorcists from the end of the fourth century to, at least, the end of the third. Two different families succeeded each other: the family of the descendents of Šangu-Ninurta[28] and the family of the descendents of Ekur-zakir.[29] The archaeological situation is a bit complex since the houses were actually built one on top of the other and posteriorly the strata were pierced by Parthian inhumations. This resulted in the mixing of the two collections. It is possible to say that there were at least 131 tablets in the most ancient library belonging to the family of

[24] Concerning the second millennium, cf. the contribution of C. Proust in this volume.

[25] (Cavigneaux 1981a, 1981b, 1999).

[26] Concerning teaching in Babylonia during the late period, see (Gesche 2001) who suggests these two levels in the education of the scribes. However, this division is not systematic: texts aimed at teaching cuneiform writing were discovered in the private libraries of the exorcists in Uruk (*SpTU* V; 276 and 277).

[27] The epigraphic discoveries of locus Ue XVIII have been published in the series *Spätbabylonische Texte aus Uruk*, first inserted in the collection *ADFU*, *Ausgrabungen der deutschen Forschungsgemeinschaft in Uruk-Warka* for *SpTU* 1, 2 and 3 (i.e. *ADFU* 9, 10 and 12) then in *AUWE*, *Ausgrabungen in Uruk-Warka Endberichte* for *SpTU* 4 and 5 (i.e. *AUWE* 12 and 13). *SpTU*5, the last volume of the series, gives the transcription, translation and hand copies of the texts.

[28] The principal member of this family is Anu-ikur; the collection sometimes bears his name.

[29] As in the preceding case, this collection sometimes bears the name of Iqiša, the main protagonist of this library.

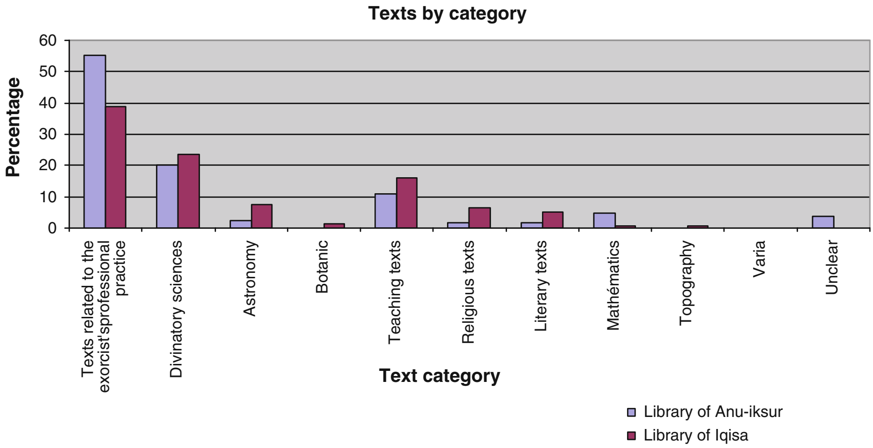
Šangu-Ninurta and 153 tablets in the library of Ekur-zakir's family. For the moment, there remain 135 tablets that cannot be attributed to the one or the other.

The determination of the use of these two collections is based on the analysis of the tablets that composed them:

Text category	Library of the family of Šangi-Ninurta	Library of the family of Ekur-zakir	Indeterminate texts (i.e. might belong to either library)
Texts related to the professional practice of the exorcists			
Conjuration	28	44	0
Medecine	44	17	4
Divinatory sciences			
Astrology	9	11	1
Hepatoscopy	2	7	0
Terrestrial divination and teratomancy	15	19	16
Astronomy			
/	3	12	9
Botany			
/	0	2	0
Teaching texts			
Lexical lists	12	24	56
School exercises (not counting the professional copies)	2	1	2
Religious texts			
Songs	0	0	3
Hymns	0	2	3
Prayers	2	5	1
Rituals	0	3	0
'Literary' texts			
Historical	0	0	1
Royal inscriptions	0	2	0
Literature	2	6	11
Mathematics			
/	7	1	3
Topography			
/	0	1	1
Miscellanea			
/	0	0	1[30]
Non-identified because of fragmentary state			
/	5	0	6

[30] A list of stones, weights of foodstuffs, wood, animals, clothes: probably a delivery for the temple.

Leaving aside the texts that have not been attributed to either library,[31] it is possible to represent the composition of these collections in the following way:



Graph 1 Thematic distribution of the texts of the libraries of the houses of the exorcists

Thus, if the proportions—instead of the number of tablets—per category are compared, the above graph is obtained: it shows the similarity of the profiles of the two collections found in the house of the exorcists. In particular, this holds true for the majority of the texts composed of documents of exorcism, connected omen texts and texts related to education.

In short, the collections of these libraries are mainly composed of texts concerning the profession of the owner and texts connected with him; they also include texts related to teaching. In this last case, let us remark that no series is complete, whatever category of documents is concerned. Therefore these collections were not built in the perspective of gathering an entire work, but rather they are the result of the learning practices of students, who were to give the master a perfect copy of a canonical work at the end of their training (copy that could either be kept by the master or integrated—as a gift—into a temple library). The incomplete nature of the series can be explained by the fact that during their training the students most often only copied the first tablets of a list. Thus, a collection that does not contain complete canonical series and rarely the last tablets of a series reflects an educational context. The

[31] Further, there were 56 lexical lists not attributed to either library. This mass of texts – texts that were a privileged aid for teaching- does not call into question the follow conclusions, quite the reverse.

important portion of commentaries is also a clue to teaching activities.[32] Finally, these libraries are also composed of a certain number of extracts[33] that can be the mark of both a pedagogical and a professional compilation. The libraries also contain works from many different disciplines, but their dominant topic is the fields of divination and exorcism. These last two activities are still very present in the palace and temple libraries and the number of tablets referring to them in the Urukean private libraries reflects at least as much the specialization of their owners as the general profile of any erudite collection.

Although the consistency and content of these libraries show the existence of instruction, there remains the question of their possible professional use. Indeed, the exorcists of Uruk were all, with no exception, employed by the Bīt Rēš, the temple of Anu (the god Anu was the most important divinity of the town during the Hellenistic period). They regularly name themselves ‘exorcists of Anu and Antu’ (the goddess Antu is the wife of the god Anu). Therefore it can be assumed that they practiced their profession in the temple; the latter paid them with rations, prebends and other benefits. However, certain medical texts specify the amount to be given to the exorcist for his services. Is this a supplementary bonus? Should it be understood as a private practice that would supplement the exorcist’s activities in the temple? Nothing is impossible in the matter. Nevertheless, although a private practice of exorcism did exist beyond the temple’s domain of responsibility, the professional texts discovered in the libraries of Ue XVIII do not allow us to confirm this assumption.

Is it really correct to talk about libraries in this context? The answer is positive, because before the areas of document storage were disrupted by the Parthian inhumations, the texts were classified. Further, these literary and erudite tablets fall within two cases. The first case, mentioned above, concerns the texts that were contained in the libraries and came from the students’ copying work. The second case concerns more specifically the tablets that could be used—among other things—as a basis for teaching: the lexical lists. These lists, which were found in large numbers, could have been gathered by the teacher according to his needs. In the same context, let us note the important proportion of commentaries, some of which might reflect the pedagogical concerns of the teachers.[34] Indeed, these texts could possibly

[32] (Clancier 2009b, 113–5).

[33] As regards the collection of Anu-ik□ur, this concerns for example the following tablets: *SpTU* 1, 44; 46; 48; *SpTU* 2, 8; *SpTU* 3, 69; 76; *SpTU* 4, 161. As regards the collection of Iqiša: *SpTU* 2, 9; 10; 21; 32; 33; 34; *SpTU* 3, 72; 97. Let us note that many tablets are damaged to the point that it is not longer possible to know their exact content. In these conditions it becomes almost impossible to identify an extract, the elements of analysis being too tenuous. Therefore it is most probable that the number of extracts is an underestimation. In a similar way, when only one tablet of a series has been copied, it is also possible to consider it as an extract. Nevertheless, the problem of the representativeness of the collections can be posed. In particular, the wax covered wooden tablets are lacking.

[34] (Clancier 2009b).

have served as a basis for teaching; this might be the case for a tablet brought back from Nippur[35] by a member of Iqiša's family descending from Ekur-zakir and containing a gloss on astrological text. This also seems to be the case for Anu-ikur, the descendent of Šangu-Ninurta, himself a specialist of commentaries.[36]

Thus, considering the present state of our documentation, it appears that both the royal court and the temple were favoured for the professional practice of the Mesopotamian scholars of the first millennium; as regards teaching, the practice within the temple could be extended to the private sphere. Professional libraries are also attested in sanctuaries.

Professional Practice

It is possible to distinguish two types of specialized collections within the temples: the library that we shall name 'professional' and the collections of specific texts such as astronomical texts.

The Library of the Lamentation-Priests of the Bīt Rēš

The library of the lamentation-priests of the Bīt Rēš, created during the Hellenistic period, is a good illustration of what was a professional collection, even if it was first thought to be a private collection.[37] In the absence of documents explaining the use of any such a collection, it is the analysis of the collection's content that permits to determine its purpose and, in this case, the professional texts play an important role.

Let us give, in a summarized way, the profile of the lamentation-priests' library that includes in total 122 literary and scholarly tablets: religious texts 66; divination (except astrology and hepatoscopy) 13; astrology 9; hepatoscopy 5; lists 5; astronomy 4; literature 3; mathematics 2; architecture/topography 2; calendar 1; catalogue 1; conjuration 1; medicine 1; miscellaneous 2; unidentified 7.[38]

This typology shows that the documents related to teaching (lexical texts and exercises) are lacking. Indeed, there is only one list in the form of extracts, but no obvious school exercise (such as lists of signs for example).[39] Admittedly,

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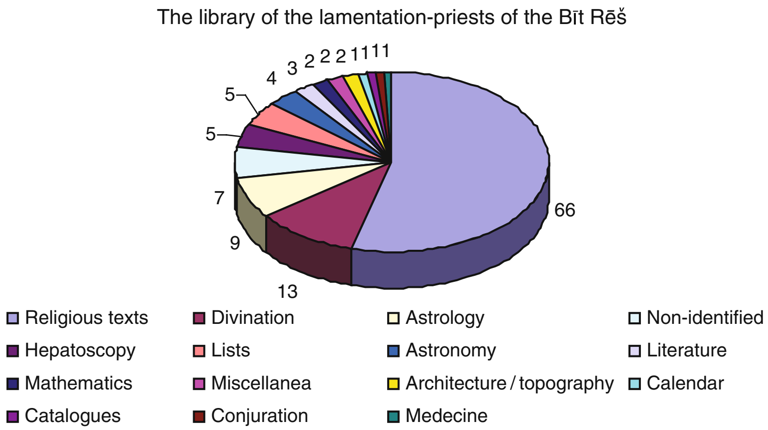
35 *SpTU* 3, 101.

36 Concerning the commentaries, cf. (Durand 1979).

37 The case of the library of the Ebabbar of Sippar, discovered in the eighties, will be left aside; an exhaustive publication of its texts still remains to be done. This library seems to have been the working library of the haruspices of the temple.

38 I have followed the typology of the editors (van Dijk and Mayer 1980).

39 *BaM* 2,8. It is a list of gods on a tablet also containing extracts of both the ritual of the lamentation-priest and the preparation of the *lilissu* (skin that was fixed on a big tambourine). There are also other lists, but none are for an educational purpose. It is preferable to designate them as works of erudition: *BaM* 2,88 (list of kings of Babylon from Kandalanu to Seleucus II i.e. from 647 to 226); *BaM* 2,89 (list of the *apkallu* and *ummânu*, a sort of dynasty of Sages



Graph 2 Thematic distribution of the texts of the library of the lamentation-priests in the Bīt Rēš

there are copies made by advanced students, but they were not carried out solely for the purpose of training, since these copies were used to renew the collections or served as canonical examples.[40] There are 8 commentaries.[41]

The typology of the documents preserved in the library of the lamentation-priests of the Bīt Rēš is very different from the one of the teaching libraries mentioned above: 88 texts out of 122 i.e. more than 72% of the tablets reflect indeed the professional practices of the lamentation-priests within the temple (religious texts (66), astrological and astronomical texts (9 + 4), mathematical texts (2)[42] and calendar texts (1), these texts are not connected to a school collection).

The patient and scrupulous analysis of the texts of this collection leads to suggest a hypothesis about the possible use of this library. Contrary to a first impression, which was in particular related to the existence of colophons all referring to the family of Sin-leqe-unnini, this collection is not a private collection belonging to priests in charge of the temple, but rather a library used by the lamentation-priests in the context of their professional activities. Nevertheless, as P.-A. Beaulieu has shown, the lamentation-priests all came from the family of Sin-leqe-unnini. The lamentation-priests' working library, located in the temple, had every reason to be supplied by members of this family. Therefore, this is not a private collection but a professional one in the hands of a group of people that succeeded in making a religious office patrimonial.

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extending from the organization of the world to the great families of Mesopotamian scholars); *BaM* 2,91 (commentary of a list of gods ?); *BaM* 2,98 (sort of compass rose).

[40] *BaM* 2, 6; 12; 65 and 75 are document that belonged to a student at the end of his training; their quality of achievement permitted the incorporation into the library.

[41] *BaM* 2, 8; 76; 77; 80; 91; 92; 93; 94.

[42] It seems conceivable that the mathematical texts might have been of use to the lamentation-priests for the writing of the documents of mathematical astronomy.

Considering the colophons of the private collections of Uruk, let us note that the library of the Bīt Rēš—this time the library of the god and not just the one of the lamentation-priests—was well furnished with texts of all disciplines. However, the collection studied here is too specialized and does not enter into this category. Further, the archival texts related to the library of the lamentation-priests are not the ones of the Bīt Rēš, but the ones of the family of Sin-leqe-unnini. Therefore, considering this example, the main library of the temple does not appear to have been found and is only known by the texts which were copied from tablets coming from the sanctuary.

However, it is possible that part of the main collection of the temple was discovered. Indeed the corpus, which was composed of the documents covering the discipline mastered by the scribes of the *Enūma Anu Enlil* i.e. astronomy and astrology, was discovered during illegal archaeological digs. It seems possible that this corpus belonged to the library of the sanctuary.

Preservation of the Astronomical Texts

It seems possible to assume that there existed other specific places of classification of texts belonging, this time, to the temple library and not to some professional collection such as the lamentation-priests' collection. Indeed, we shall see below that the temples owned large collection of literary and scholarly tablets, the organization of which is not understood. However, it is possible that the texts of mathematical astronomy—similar to the ones in *ACT*[43] and discovered by the clandestine excavators on the site of Uruk at the beginning of the twentieth century—came from specific storage places that were not recorded at the time.

This documentation can be divided into three main groups:

1. *Ephemerides*.[44] These are lists used to predict the phenomena related to the moon and planets. There are two categories of texts depending on the type of calculation used to establish these predictions. They are found in Uruk and Babylon.
2. *Auxiliary tables*.[45] These documents are closely linked to the previous ones. Indeed, insofar as the establishment of lunar ephemerides requires much calculation, the latter are sometimes written down separately.

[43] O. Neugebauer published the texts of mathematical -or theoretical- astronomy in *ACT*, *Astronomical Cuneiform Texts* (Neugebauer 1955). The corpus of texts is composed of 312 tablets of which 201 come from Babylon, the rest comes from Uruk; they all date -or can be dated- from the Late Babylonian period. Since O. Neugebauer's work, about fifty supplementary documents of this type have been identified (cf. Aaboe 1968, 1969, 1971; Aaboe and Hamilton 1979 and for a bibliography of these texts and of the *ACT*, cf. Hunger and Pingree 1999 and Steele 2002, 293).

[44] These documents are also named 'Greek-Letter Phenomena' because (Sachs 1948, 274) designated the phenomena described in them using Greek letters. Cf. also (Neugebauer 1975, 386) and (Boiy 2004, 30).

[45] The documents of this type have been published in *ACT*, supplemented by (Aaboe 1968, pl.1 (A,B,C and D); pl. 2–3; 1971, pl.1 (A,B,C and D)) and (Steele 2002, 298–301).

3. *Procedure texts*.[46] These are not texts of astronomical data; they are 'manuals' 'explaining' how to perform the calculations in view of making the tables.

These different texts all represent the same discipline mainly attested in Uruk and Babylon.[47] Concerning Uruk, the establishment of mathematical astronomy was the responsibility of two major families: the family of Sin-leqe-unnini and the one of Ekur-zakir. The abundance of colophons ascribed to the descendents of Sin-leqe-unnini may have led to believe that a major part of these tablets came from the lamentation-priests' library mentioned above. The problem that such a hypothesis raises is that the so-called library contained virtually no astronomical document. It must therefore be assumed that either the clandestine excavators sorted the astronomical texts out or the texts were stored elsewhere. The first assumption is unlikely since the excavators in question certainly could not read the cuneiform texts. The fact that two families shared the writing of these *ACT* seems to me to imply that these works fell to two professions: lamentation-priests in the case of the descendents of Sin-leqe-unnini and exorcists in the case of the descendents of Ekur-zakir. Therefore these texts must have been preserved in a common place, accessible to both professions and not in a library specifically designed for the one or the other.

These collections of astronomical texts must have been found in a specific place discovered by the clandestine digs. This probably was not a particular professional library, but rather a room—or part of a room—devoted to this type of documents. This is even more obvious concerning the library of the Esagil in Babylon. In this case, the astronomical documents of the library—*ACT*, but also astronomical diaries[48]—were written by 'astronomer-astrologists' and this task constituted their main activity. Thereafter, the documents were placed in the library of the temple. It is probable that they also had a specific storage place since the lamentation-priests and exorcists, among others, would have needed to consult them.

Let us now consider the main libraries of the temple. They can be approached using the notion of non-specialized (i.e. general in scope) and encyclopaedic collections.

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[46] (Neugebauer and Sachs 1956, 131).

[47] The direct observations of celestial phenomena are principally documented in Babylon (with some very rare texts in Nippur and Uruk). They gave rise to the establishment of documents that are called astronomical diaries; these diaries will be considered below with respect to Babylon.

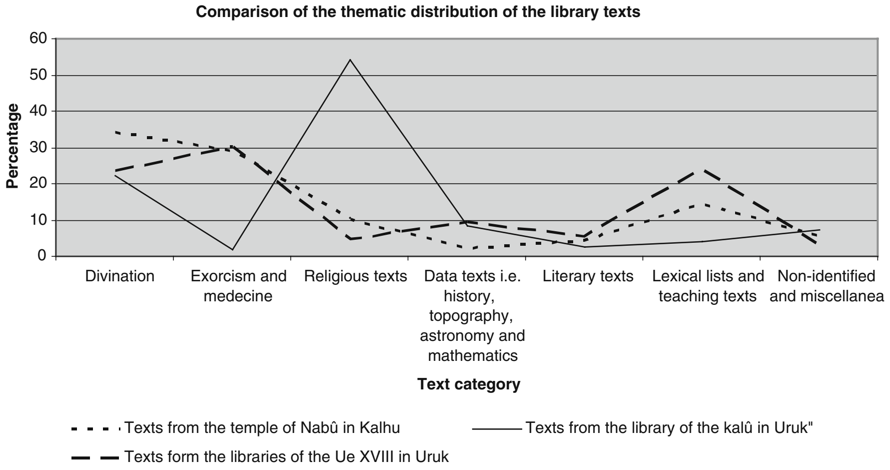
[48] These are daily observations of the sky. They were completed by notes on the remarkable events of the day, the price of grain on the Babylonian market or the level of the Euphrates. The reference publications of these texts are the *Diaries*.

Patrimonial and Encyclopaedic Preservation

The priests in charge of the major sanctuaries seem to have been keen to maintain the collections as complete as possible. There are several reasons for this, but the result was the creation—resources permitting—of encyclopaedic collections.

The Temple Library

The best preserved temple library to date is the one of the Ezida, the sanctuary of Nabu in Kalhu (Nimrud), it dates back to the seventh century. It can be compared to the libraries of the lamentation-priests and exorcists of Uruk, all of them discovered during well conducted archaeological excavations.[49]



Graph 3 Comparison of the thematic distribution of the library texts

Although the library of Nabu in Kalhu only had an average size collection (259 tablets), its contents are non-specialized (i.e. general in scope). The canonical series related to divination and exorcism are predominantly represented alongside many lexical lists. The profile of the library is similar to the one of the Urukean private libraries. This is hardly a surprise. Indeed, the omen series, which form a major part of the Sumero-Akkadian literature, served many priests such as haruspices, astrologists, exorcists and lamentation-priests. Therefore these series had pride of place in the temples. Further, if the medical

[49] I shall not compare these libraries with the royal Assyrian libraries or the library of the Esagil in Babylon. The conditions of their discovery do not permit us to be certain that all the rooms are known.

texts were only of interest to the exorcists, the lamentation-priests in some cases could be concerned by texts of exorcism.[50] Finally, the temples tried to preserve the lexical series in their greatest extent. This phenomenon can also be observed in Babylon. They served, as mentioned earlier, both for teaching and as compilations of knowledge. The conspicuously low proportion of data texts, i.e. historical, topographical, astronomical and mathematical texts, shows a simple fact: this was not a deliberate choice in the making of the collections, but rather the reflection of the normal proportions considering the various types of texts.[51]

A structural difference between the non-specialized and specialized collections can immediately be established. For instance, this can be seen by comparing the exorcists' library in Uruk—or the library of Nabu in Kalhu—with the library of the lamentation-priests of the Bīt Rēš in Uruk. Indeed, the latter predominantly contained rituals, which are specific to the profession of lamentation-priests, and hymns—both necessary to lamentation-priests—and divination texts. This over-representation is the hallmark of specialization.

This last case stands as a peculiarity in comparison to the more comprehensive libraries such as the exorcists' library in Uruk or the one of the temple of Nabu in Kalhu. However, it is not because these libraries are broad in scope that they are necessarily encyclopaedic.

The Palace Libraries and the Library of the Esagil

What strikes at first in the study of the contents of the royal Assyrian libraries of Nineveh —or the library of the Esagil temple in Babylon—is the enormous amount of texts that could be called functional. In the Assyrian case, these texts are series, letters and other reports on particular situations, which potentially could affect the king's health and the kingdom. This is the case, for instance, regarding climatic phenomenon, monstrous births and eclipses i.e. phenomena that may express a negative state of mind of the gods towards the king.[52] In Babylon the astronomical texts, supplemented by the astrological series, constitute the major part of the tablets coming from the temple of Bēl-Marduk

[50] Further, the important number of texts of medicine and exorcism that were present in the temple libraries seems also to reflect the favorable position held by the exorcists. Indeed, besides the exorcists' great erudition revealed by the private libraries in Babylonia and Assyria, their sole number was important. Thus, in Babylon whereas the Esagil employed 6 haruspices (rations list BM 78997), 14 astronomer-astrologists (rations list YBC 11549), 50 lamentation-priests (rations list *CT* 44, 84), there were more than 100 exorcists (rations list HSM 1893.5.6).

[51] The library of the Esagil in Babylon is an exception to this rule since, as major astronomical centre, it held a number of astronomical data texts both astronomical diaries and documents of mathematical astronomy. Further, a historiographic tradition having developed there, the Esagil became the major production centre of historical texts in the Achaemenid, Hellenistic and Parthian periods.

[52] With respect to this literature, see (Hunger 1992 and Parpola 1993).

(over 3000).[53] Next to this enormous mass of texts, the literary texts and series—other than divination texts—may appear of little importance if we solely compare the proportions of the different texts.

Thus, concerning the royal libraries of Nineveh, L. Oppenheim wrote:

> The contents of these tablets clearly indicate that the cuneiform literature which the Mesopotamians themselves considered essential and worthy of being handed down, concerned, directly or indirectly, the activities of the diviners and of the priests specializing in exorcistic techniques. Only a very small section contains what we, immersed in the Western tradition, like to call products of literary creativeness. (...) The explanation for all this is quite simple. What we have at hand in these twelve hundred or more tablets is but a reference library geared to the needs of the diviners and those specialized practitioners of magic who were responsible for the spiritual security of kings and other important persons. (...) By accident, and hardly for what we would call their merits, literary texts were carried along in the stream of tradition as part and parcel of the education of the scribes simply because the copying of such texts belonged to the traditional curriculum.[54]

Therefore according to L. Oppenheim, everything in the royal libraries was functional and directed exclusively towards the protection of the king. Anything that diverged from this standpoint was kept only for educational purposes. However, when the libraries are compared, it can be seen that the profiles of the temple libraries such as the Ezida of Kalhu or the Esagil of Babylon[55] are extremely similar to those of the royal libraries. Even more remarkable is the fact that the same works are found in both types of libraries whatever the discipline. Let us further consider the large libraries like those in Nineveh and Babylon, not only do we find the same works, moreover they are complete. The similarity of the collections of these two types of libraries can be in fact explained by a common objective: the magical protection of individuals—and hence the central position given to divinatory works—and the patrimonial preservation of the works of the Sumero-Akkadian culture which constitute a coherent collection of knowledge from which scholarly disciplines developed. It is not known whether there were works of other cultures (Aramaic and Greek in particular) for clay is the only medium that was preserved in Iraq; therefore any text written on wax, parchment or papyrus, with very rare exceptions, has disappeared.

Thus, not only was the function of the temple and priests to protect and guide mortals in a world visited by immortal powers, their role was also to preserve the Sumero-Akkadian tradition and develop it. In this context, the function of the temple library was, among other things, to be a place of reference, where it was possible to gather, consult and work on the texts. It is precisely these

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[53] (Clancier 2009a, 206).

[54] (Oppenheim 1964, 19–20).

[55] It would be possible to add to this the large library of the Ezida, other temple of Nabu, in Borsippa. And although it is in a very bad state, it seems that the main library of the Bīt Rēš might also have similar features.

sources, which were preserved in the temples, and sometimes also the sources owned privately that supplied the collection of the Assyrian kings; and in turn the latter became a place of tablet preservation.[56]

The library of the Esagil of Babylon certainly played both the roles of temple and royal library. Indeed, the Babylonian royal power seems to have promoted astronomy by the creation of the astronomical diaries.[57] This had two consequences. The first concerns the protection which was enjoyed by the clergy in charge of the temple. The Babylonian kings had to be attentive and render their work possible. For this, economic support was necessary. This situation is all the more logical that the first mission of the monarchs was to meet the needs of the sanctuaries. Furthermore, according to the correspondence of the *šatammu* (administrator) of the Esagil with the Assyrian king Esarhaddon (680–669), the official in charge of the sanctuary of Bēl-Marduk was already, in the seventh century, at least also in charge of all the other temples of the town.[58] The economical situation of the scholars related to the temple did not seem to have been a problem until the first century B.C.

The second, and most direct, consequence concerning the organization and distribution of the collections of literary and scholarly tablets on the site of Babylon is to consider that Nabonassar (747–734) did not constitute a royal library following the example of the Assyrian kings of the seventh century in Nineveh, since he had directly called on the astronomers of the Esagil and had let them officiate within the framework of the temple. The Esagil and its priests appear to have played the same role in Babylon as the one played by the royal libraries—and the 'spiritual guardians'—of the Assyrian kings in Nineveh. Thus, the Esagil was at the same time a temple and a royal library; this may explain the unequalled extent of its collection and the power of its priests. The specificity of Babylon as the main centre of astronomical research in Babylonia is possibly related to the presence of the king. Indeed astrology, which exploits a major part of the astronomical results, was closely linked to the king and could therefore be expressed here in all its magnitude. The creation of a specific research centre in this field—fostered by the king and designed for his protection—probably led to the establishment of the city as a 'School' and to the development of areas of expertise. The latter do not seem to have been exported much considering the celestial observations given in the astronomical

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[56] Although we cannot discuss this phenomenon in more detail, the preservation of texts is far from being the only activity of the temples. Several disciplines were developed in the temples during the Hellenistic period, for instance mathematical astronomy, erudite practices that led to the creation of commentaries and an important historiographical tradition informing us today of Hellenistic history from a Babylonian standpoint. This erudite environment seems quite far from an ossification at the end of the third and beginning of the second centuries B.C. (Clancier 2009a, 255–317).

[57] (Rochberg 1991, 108–9).

[58] (Landsberger 1965).

diaries.[59] This might explain the overwhelming number of texts of this type discovered in Babylon.

Thus, the libraries found in Assyria and in Babylonia allow us to partly understand the functioning and the prerogatives of the Sumero-Akkadian scholarly environments in the first millennium. But if the composition and use of the collections of literary and scholarly tablets have been considered, it remains to understand the supply, the material organization and the dynamism of these centres of knowledge.

Formation and Dynamism

The Enrichment of the Collections

The formation and maintenance of the scholarly and literary tablets were based on copying. The clay tablets—most often raw—constituted a relatively fragile medium, even if paradoxically it is precisely the one that stood the best the test of time. Nevertheless for the users of these tablets, shocks, frictions or falls could cause the disappearance of a portion of the text or even the destruction of the entire tablet. This medium, essentially rigid, could break easily. Besides, the writing was inscribed on a very pure and thin layer of clay; this layer was applied onto a coarser core. It could break off if it were mishandled or simply due to the ageing of the tablet. To preserve a text in perfect state it was therefore necessary to regularly copy it.[60]

All the tablets found in libraries were not intended to be copied. The tablets that were copied regularly were essentially the canonical works as fixed at the end of second or at the beginning of the first millennium (epics, hymns, oracular series, medical series, rituals etc.) The colophon bears the following: 'Tablet of PN[61]1. Hand of PN2' and possibly blessings (or curses). It could specify from which original text the copy was made. A colophon almost ideally developed for the historian is, for instance, the one of a tablet from Uruk belonging to the private library of the family of Ekur-zakir within the house of the exorcists:

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[59] Two come from Nippur: *Diaries* 5, 63 and *Diaries* 5, 57. Five may come from Uruk: *Diaries* 5, 82; *Diaries* 5, 74; *Diaries* 1, -463; *Diaries* 5, 103 and *Diaries* 3, -99 C. Other than *Diaries* 1, -463 and *Diaries* 3, -99 C are lunar and planetary texts. Let us note that, in the case of this last town, the only true astronomical diary is the one discovered in the library of the lamentation-priests of the Bīt Rēš, the others are in fact compilations of eclipses according to an 18 year period. The attribution of the text *Diaries* 3, -99 C poses a problem and is not certain. The remaining astronomical journals come from Babylon, i.e. 522 tablets. Concerning the erudite activities of the Esagil cf. (Beaulieu 2006).

[60] This phenomenon concerns the library tablets, but not the legal documents such as contracts or other official texts (e.g. title deeds). In this case, it is the original tablet – with possible double originals- containing the text, the list of witnesses and the seals that was to be kept.

[61] PN: personal name.

> Written and established according to an original writing board (a wax-covered wooden tablet) from the Treasure of Anu and Antu. Tablet (commissioned by) Anu-ah-ušabši, son of Kidin-Anu, descendent of Ekur-zakir, the exorcist of Anu and Antu, *šešgallu*[62] of the Bīt Rēš, the Urukean. Hand of Anu-balassu-iqbi, his son. He wrote for his understanding, the lengthening of his days, his physical and moral well-being and the stability of his position. In Uruk and in the Bīt Rēš, temple where his lordship resides (…)[63]

Such a colophon constitutes a mine of information on the practice of copying tablets as well as for the history of the sources. First, it indicates that not all originals were made out of clay, but could also be made out of wood coated with wax.[64] Moreover, in this particular case, the scribe mentions the exact writing place of the tablet, 'in Uruk and in the Bīt Rēš, temple where his lordship resides'. In most examples at our disposal, the colophons do not mention the temple as a writing place, although it was in the temples that most of the copies were probably made. Then comes either the name of the owner of the tablet or the latter followed by the name of the writer of the tablet. Even though we are here in the private sphere, such inscriptions also appear on tablets found in temples and this allows us to know who made the copy. Let us note that these indications do not refer to a true notion of property. It would be more appropriate to talk about the person who commissioned the tablet rather than owner.

The copy was made according to two different perspectives, often complementary: the education of the young scribes and the renewal of the collections of scholarly and literary tablets. The learning of cuneiform writing on clay—independently of any level—was most often achieved by the copying of documents. This type of training began early, as soon as the student had started learning cuneiform signs.[65] Concerning the Late Babylonian period, the difficulty for us is to distinguish the training tablets from those copied in order to renew the collections.

For this period, when student tablets are mentioned, it is above all with reference to the second type i.e. already professional copies. Indeed, the first stages of learning are not as well documented as it is the case for the second millennium. This may be linked to the history of the discoveries or to the fact that the school tablets, less attractive to clandestine excavators, did not reach

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62 The term *šešgallu*, the Akkadian form of the Sumerian šeš.gal, literally means 'big brother'. As it represents a religious function it could be translated by 'great priest'; however this does not shed light on the function itself. Thus it seems preferable to keep the Akkadian term (*CAD* Š/2: 336).

63 *SpTU* 1,2. $^{5'}$[*k¯ma*] sumun-*šú* sar-*ma ba-rù ù up-puš₄ ga*[*ba-ri* $^{\text{giš}}$d]a níg.ga $^{\text{d}}$[60 *u an-tu₄*] $^{6'}$[im] $^{\text{1d}}$60.šeš.gál-*ši* a *šá* $^{\text{1}}$*ki-din-*$^{\text{d}}$60 šà.bal.bal [$^{\text{1}}$*é-kur-za-kir*] $^{\text{lú}}$[maš.maš $^{\text{d}}$60 *u an-tu₄*] $^{7'}$[$^{\text{lú}}$šeš].gal-*i šá* é *re-eš* unug$^{\text{ki}}$-*ú qa-at* [$^{\text{1d}}$60]-din-su-[e *mârišu*] $^{8'}$[*ana*] *a-ha-a-zi-šú* gíd.da u₄.meš-*šú* din zi.[meš-*šú u kunnu išdēšu išurma*] $^{9'}$[*ina* unug]$^{\text{ki}}$ *u* é *re-eš* é en-*ú-ti-šú ú-k*[*in*] (…).

64 There are even some references to copies made from *magallatu* i.e. parchment scrolls. This case is very rare and raises the question of the possible passage of certain categories of texts from clay to parchment in Babylonia during the Hellenistic period (Clancier 2005, 90–1).

65 Concerning the curriculum of the apprentice scribe, see (Cavigneaux 1982 and 1999).

the prestigious museum collections. And in the particular case of the northern Babylonian sites, the tablets concerning the Late Babylonian period were essentially collected at the end of the nineteenth and the beginning of the twentieth centuries in the context of these clandestine digs. However, the students' entire curriculum in the late period is known thanks to the temple of Nabu *ša harê* in Babylon. It sheds light on the continuity of the educational system, since all levels of competence are represented, from the initiation to the highest levels of scribal expertise. The school texts recently published by P. Gesche, a number of which come from the Esagil, confirm these facts.[66] The renewal of the collections was provided by the copying work of the apprentice scribes. The copied tablets were placed either in private collections or in temples. The apprentice scribes nevertheless only copied the first tablets of the canonical series. It was the recognized scholars who copied—during their entire lives—most tablets of the series and therefore ensured the renewal of the texts. This explains why the presence of the single name of the commissioner (who is then also the scribe) is a common case.[67]

Thus it seems that L. Oppenheim's words—when he said that all copies, and hence the creation of libraries, were caused in one way or another by scribal training—ought to be somewhat qualified.[68] Indeed, it can be seen that the authors and recipients of certain tablets are not related to teaching: for example, tablets of fathers writing on their son's behalf[69] or exchanges between people of similar educational status[70] that appear either as commissioner and scribe or mere commissioner. Further, recognized scholars continued to copy the canonical texts. Therefore, the copying or the creation of texts was not only done in an educational context. The physical renewal of tablets and the willingness to keep, in a particular collection, a given copy must have also played an important role in the formation and maintenance of libraries.

The copying process went hand in hand with the disappearance of the original tablets either because the clay of the latter was reused or because they were disposed of, often only to be used again as construction material. In the first case, the original has definitely disappeared.[71] In the second case, there always remains a chance of finding it in a secondary context i.e. different from its normal use.[72] Indeed, the colophons do not trace—apart from some very

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66 (Gesche 2001).

67 For some examples among others:*SpTU* 3, 65 et 74; *ACT* 123 et 123a.

68 (Oppenheim 1970, 25).

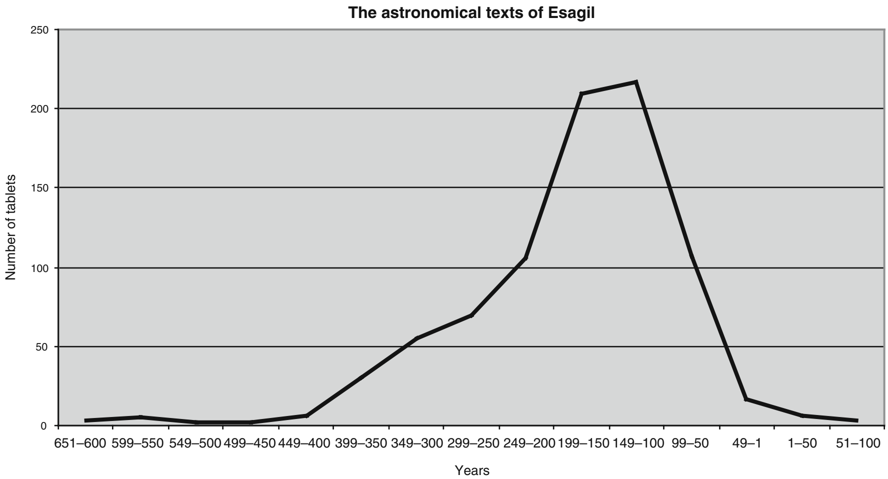
69 *ACT* 101 where Anu-ah-ušabši, a descendent of Ekur-zakir, wrote for his son Ina-qibit-Anu.

70 *SpTU* 1, 126 and also *TCL* 6, 27 = *ACT* 501.

71 This case is documented in the house of the *āšipu* of the family of Ekur-zakir in Uruk, where tablets were found agglomerated in lumps and waiting to be reused (Hoh 1979, 28). Concerning tablet recycling, cf. (Faivre 1995 and Charpin 2003, 490).

72 (Charpin 1985) and cf. the case of literary and erudite tablets in association with the archives of the Esagil 2, in (Clancier 2009a, 195–200).

rare exceptions—the history of the original copy.[73] So, when a library is discovered, it is always in its last state of copy supply, making it potentially very difficult to trace its history over more than one or two generation. Fortunately, in the cases where the libraries are coupled with very active working centres, as it was the case for the Esagil, there are facts that help trace its history. Indeed, the data texts i.e. the astronomical diaries, the texts of mathematical astronomy and the historical chronicles were rarely copied.[74] But, such documents, and in particular the astronomical texts, are dated or datable. It is this archival documentation of astronomical texts that permits to assume, for instance, that the library of the Esagil was in operation, without much disruption, from the middle of the seventh century B.C. to the end of the first century A.D.:



Graph 4 Evolution of the number of astronomical texts during the first millennium in Babylon

[73] Nevertheless, the scribe Šamaš-eir, son of Ina-qibit-Anu, descendent of Šipkat-Anu, mentions in tablet *TCL* 6, 38 that he went to Elam to consult the original and this during the Hellenistic period. This original was in fact an Urukean tablet taken by Nabopolassar (king of Babylon from 626 to 605). Such an explanation in a colophon is extremely rare.

[74] Certain historical texts such as the Neo-Assyrian and Neo-Babylonian chronicles were regularly copied. This is no longer the case in the Hellenistic period when, however, this type of document was very popular. The preliminary publication by R. van Spek of the Babylonian chronicles of the Hellenistic and Parthian periods (www.livius.org) gives access to such documentation.

The above curve shows that the major part of the intellectual activity of the Esagil of Babylon took place during the third and second centuries B.C. Thereafter, for many reasons that cannot be developed here, this dynamism declines. However, this curve is misleading; it does not represent the period of greatest activity of the temple, but its last true period of dynamism. Indeed, the increase in the number of tablets produced annually starting from the end of the fifth century is not so much the indication of an increase of the workers' activities in the Esagil as an indication of the preservation of the tablets. The texts of astronomical data, the astronomical diaries and the mathematical astronomy texts were not copied in the majority of cases, so the increase in tablet number per year could simply indicate that these tablets were in good enough a condition and useful enough to be preserved during the last stages of functioning of the temple. If this had not been the case, they would have been disposed of and we would not have found them. The individual preservation of astronomical diaries between the middle of the seventh century and the end of the fourth seems to have been the exception. This exception permits to situate chronologically the library of the Esagil between 651 B.C. and at least 75 A.D. It is even possible to go slightly further back than 651.

The Physical Organization of the Libraries

When discovered within a clear archaeological context, the tablets help the historian form an opinion about what might have physically been a Mesopotamian library both private and institutional. This organization varies from one library to another, or more precisely, the modalities of preservation and disposition of the tablets seem to have been different in the case of private and temple libraries.[75]

The literary and scholarly tablets of the private libraries could be preserved on shelves, in jars or placed in piles.

In the case of the most ancient house of the exorcists of Uruk, the house of the family of the descendents of Šangi-Ninurta (end of the fifth century-beginning of the fourth), the texts were kept in two different ways. A first part of the tablets was stored in jars according to a well attested practice in the Ancient Near East. The jars—containing numerous tablets of literary and scholarly content associated with the family archives—were placed on a thin layer of ashes in a small room (no. 4) of 2 m by 1.6 m. Alongside these batches other tablets had simply been piled up.

The case of the house of the descendents of Ekur-zakir (fourth-third centuries), which was stratigraphically situated above the house of the family of Šangi-Ninurta, offers a more complete panorama of what the house of a scholar

[75] The discoverers of the palace libraries of Nineveh did not record their archaeological context with enough care for us to be able to get a precise idea of them.

and teacher might have looked like in Uruk during the Hellenistic period. A niche was discovered in room 1 of this house. It was filled with baked tablets. The fact that these tablets were all baked is quite rare.[76] They were placed on edge against each other. The rest of the tablets of this stratigraphical level were disturbed by the posterior Parthian graves. They were associated with an interesting material: room 3 of the house was equipped with an oven which could have been used to bake the tablets, and a baked brick socle next to which other baked tablets were discovered, apparently these tablets were piled up. Finally, in this same room bone stylets and clay tablets—with lines already traced on them—were found. These examples show that the tablets were subject to a particular treatment regarding both their production in the domestic environment and their storage.

As for the literary and scholarly tablets of the temple libraries, it seems that they were most often kept in storerooms set up for this purpose for instance with shelves in the walls. These rooms were sometimes too narrow to be used as consultation rooms. The storerooms must have opened onto rooms—or courts—in which the consultation of the tablets took place. The best example of this layout is attested in the Ebabbar, the temple of the sun god Šamaš in Sippar. Some 800 tablets were kept in a room (355) of 4.40 m by 2.70. It only had one door and the three blind walls were covered with clay compartments. The clay compartments were coated with plaster and reinforced with reed. The vast majority of tablets were still on the shelves. In general, they are large and finely inscribed as one would expect for literary or scholarly tablets. About ten texts were found on the ground left to the entrance,[77] another 8 seem to have fallen from the upper shelves.[78] The niches containing the tablets were 70 cm deep, 25 cm high and 35 cm wide,[79] the average width could vary 'presumably to fit suitably the tablets of appropriate dimension'.[80] The latter rested on a socle formed of three layers of mudbricks.[81] The long wall facing the entrance had 16 niches, the right wall also had 16 niches and the left wall had 12 or 16 niches depending on the adopted reconstruction choices.[82] Thus there are 44 or 48 niches. The state of preservation, though exceptional, seems to indicate that this number might have been as high as 56, because the walls were partly damaged on their upper part.[83] The niches were built in a similar manner to those

[76] The classification of these texts was not recorded. This is a surprise considering the recent date of the German excavations in this sector i.e. 1969–1972 (Schmidt 1972, 56). Further, it is impossible today to know which tablets were -and which ones were not- on these shelves by merely reading the excavation reports and the publications of the texts.

[77] These texts were lexical lists (al-Jadir 1998, 714).

[78] (al-Jadir 1987, 23).

[79] (al-Jadir and al-Adami 1987, 30).

[80] (al-Jadir 1991, 194).

[81] (al-Jadir 1991, 194).

[82] (Pedersén 1998, 194).

[83] (al-Jadir 1987, 20; Pedersén 1998, 194).

discovered in the temple of Nabu, room H5, in Dur-Šarrukin, nowadays Khorsabad.[84] Thus, this was a recurrent mode of storage of clay tablets. In Sippar, the tablets were arranged on the long wall facing the entrance and on the left wall. The right wall contained few cuneiform texts. The probable reason for this is: either a space was deliberately left empty or this place comprised shelves containing wax covered wooden tablets or parchments.

The layout of these storerooms constitutes a problem. In the case of the Ebabbar of Sippar, the library of room 355, in the north-west, was quite a distance from the other sector containing literary and scholarly tablets i.e. rooms 53 and 55[85] on the other side of the great sanctuary in the south-east. It seems that the room 355 was the professional library of the diviners of the temple, while the library of rooms 53 and 55, which was found in connection with the temple administrative archives, evokes more the Treasure of the god.[86] Rooms 53 and 55 have provided more than 35,000 tablets, essentially administrative tablets, but also literary and scholarly ones. It remains difficult to know whether this is really a library, since the global analysis of this batch still remains to be done. For the moment only the administrative archives have been studied.

The distribution of the scholarly texts throughout the various buildings of the temple complex seems to have been a common practice and can also be seen in the Bīt Rēš in Uruk, where the lamentation-priests' library was separate from the god's library. However, it appears that the latter must have globally been situated in the same wing of the building, as it was possibly the case in Sippar. Although the discovery of the library of the Esagil in Babylon was mainly due to the work of clandestine excavators, H. Rassam—the archaeologist appointed on the site by the British Museum between 1879 and 1882—was able to complete this discovery. The few archaeological data at our disposal allow to say that the major part of the literary and scholarly tablets of Hellenistic Babylon were found south of the Esagil temple, possibly within the so-called 'Juniper Garden' where shrines, gods' treasuries, temple assembly buildings and storehouses were situated.[87]

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[84] (Pedersén 1998, 155).

[85] The tablets of these rooms, discovered by H. Rassam at the beginning of the 1880s, were mixed up and badly registered; this makes their use very difficult today.

[86] This designation covers all the god's possessions and not only his library.

[87] Concerning the topographical situation of the library of the Esagil, cf. (Clancier 2009a, 180–5).

Conclusion

The history of cuneiform tablets, which has shaped our way of writing Mesopotamian intellectual history, is punctuated by two chronologically distant stages. First, there is the actual life of the text. The profile of our corpuses is determined by the choice of the text and its copying and transmission modes. The Mesopotamian practice was to continually copy the text because the medium on which it was written—clay—was not solid enough to ensure its durability. Thus, regularly, a tablet would replace another that contained the same text. The copy was duly registered in the colophon, but the latter could only contain a limited amount of information and, in particular, the history of the different exemplars which had been copied and even the date were lacking. Therefore, it is impossible to estimate a tablet's lifespan before it was copied again. This is all the more regrettable, since it is not possible either, in such a context, to give a chronological framework to the libraries on the sole basis of the literary and scholarly tablets. The main consequence of the regular copying of tablets, without recording the data that concerns the transmission of the texts, is: when a library is discovered it almost only provides tablets that were written close to the end of its functioning. A true history of the collections depends on the texts that were not copied such as the astronomical texts, however these texts were not kept in all libraries, quite the reverse. In the most frequent case, the text was copied and the old tablet, which had served as the original copy was either disposed of or remodelled. In this last case, all trace of the text is usually lost. As often, 'waste-bins' are mines of information. In the case of the Esagil of Babylon, they have allowed us to give a pace of life to the temple library, at least regarding the Hellenistic and Parthian periods. This shows how the ancient practices determine the existence of our corpuses of texts.

But the burying of a tablet does not end its history. Important centres of knowledge were found on certain sites such as modern Erbil in northern Iraq, ancient Arba'il. This site has been continuously occupied since the Assyrian period and any archaeological operation is virtually impossible. But, many tablets still reach us. Here too, the research history of the sites has important consequences on the composition of the corpuses. It has only been possible to talk about the libraries of the Esagil of Babylon—and of the Ezida of Borsippa—after much work: the reviewing of the sparse information at our disposal on the discovery of the tablets coming either from plundered sites or from sites excavated too long ago. In any case, the study of such examples would have been impossible without the discovery of other libraries since the 1950s, this time under suitable archaeological conditions.

A unique collection is not sufficient to give a good idea of what libraries might have been like in Mesopotamia during the first millennium. Indeed, it has been possible to present two archaeologically well documented examples: the professional library holding a very specialized collection and the private

libraries that seem—at least in Uruk—to have been related to teaching activities. The non-specialized collection of the Ezida, the temple of Nabu in Kalhu, could also have been presented. Be that as it may, it is now obvious that a study of Mesopotamian libraries cannot be based on a sole example, however well-preserved it might be. Indeed, it is the actual diversity of the modes and objectives of the formation and administration of the libraries that determines their various profiles. Further the conditions, in which the buildings hosting the tablets were abandoned and their subsequent exploitation as a quarry, or even their reuse for other scholarly practices, have a very strong impact on the lessons that can be drawn from them today. The documentation at our disposal is now rich enough for us to be able to establish a typology of the Mesopotamian libraries of the first millennium:

1. Teaching seems to have been the source or the purpose of the private collections. However, some libraries do not follow this pattern e.g. the Neo-Assyrian library belonging to Kiir-Aššur and his nephew Kiir-Nabu, both exorcists. The latter was composed of some 800 tablets and was discovered in Aššur. It seems to have been oriented more towards professional practice than teaching.
2. The professional collections are well represented by the lamentation-priests' library of the Bīt Rēš in Uruk and the library of room 355 of the Ebabbar in Sippar, which was the library of the haruspices of the sanctuary.
3. Finally, there were the non-specialized temple libraries—i.e. general in scope— (for instance the Ezida of Kalhu) and the encyclopaedic collections both in certain sanctuaries (e.g. the Esagil of Babylon, the Ezida of Borsippa, the Bīt Rēš of Uruk) and, of course, in the Assyrian palaces of Nineveh. On all considered sites, the major temple collections seem to have served both as a model and as a documentary source. Thus, the temples were genuine places of preservation of the Sumero-Akkadian tradition. The most dynamic temples, such as the Esagil of Babylon, were places of creation in the fields of mathematics and astronomy, literature and history.

Concerning the Mesopotamian civilization of the first millennium, the importance of these collections goes beyond intellectual history into the domain of political history. In 539, the Babylonians loss their independence in favour of the Persians. The new masters of the country widely relied on the support of the local notability to rule their new conquest. The temples—the major urban economical power—that had been close to the defunct Babylonian power were privileged as such. Indeed, the priests in charge of the sanctuaries became major interlocutors for the Achaemenid and Macedonian rulers. So, although the extent of its prerogatives is still a matter for debate, the great temple of Babylon, the Esagil—represented by its administrator, the *šatammu*, its assembly, the *kiništu* and the Babylonian notables—was a political and economical power that was quite superior to what could still be conveyed by the cuneiform texts. The scholar of the Hellenistic period had become, due to his activities in

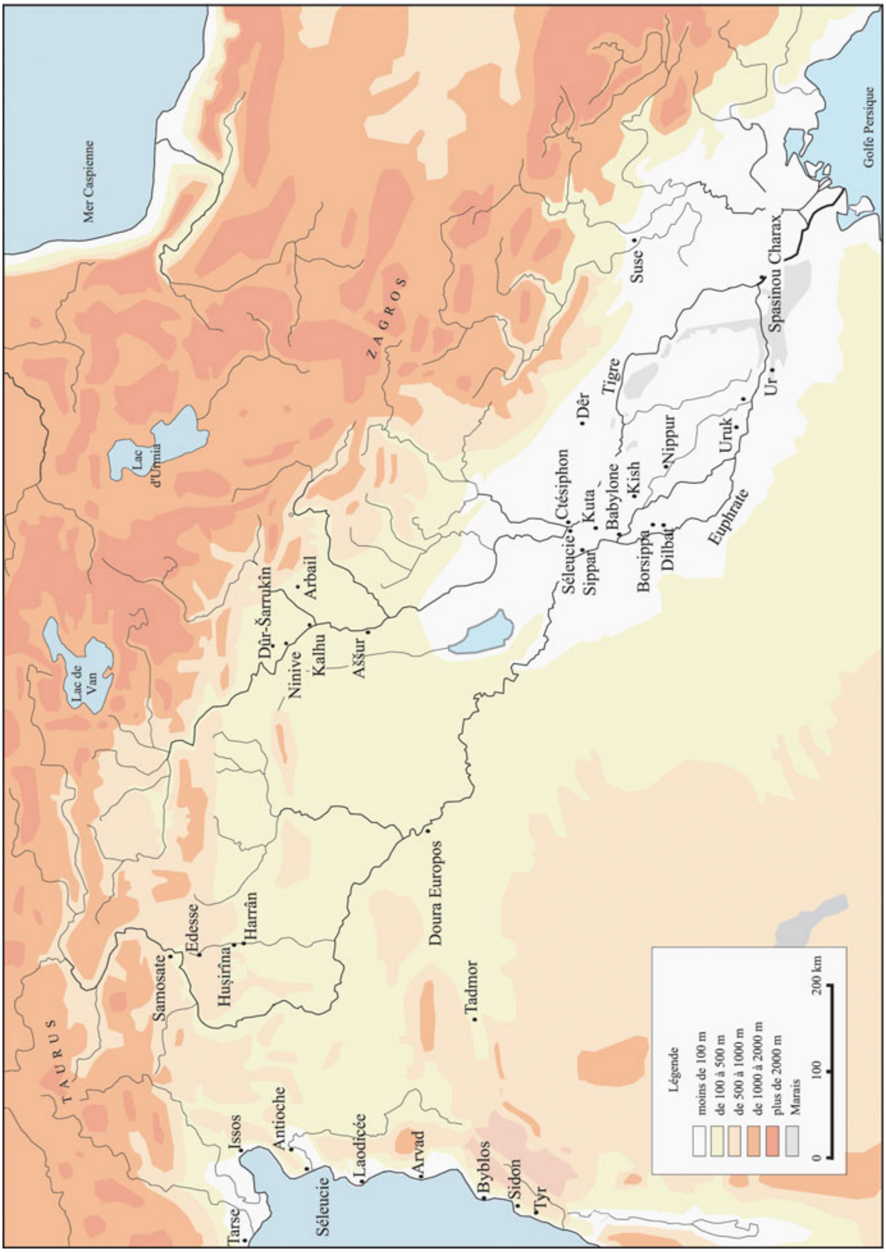


Fig. 1 The near-east in the first millennium

the sanctuaries, a man with major economical and political responsibilities and a person on whom the Greco-Macedonian power was to rely until the beginning of the second century B.C.

However, and despite the thousands of tablets at our disposal, our documentation is partial. Our work is solely based on the preserved cuneiform texts, i.e. a very small fraction of the texts written on clay during antiquity. The representativeness of this fraction of texts constantly needs re-evaluating. Indeed, during the first millennium the use of parchment spread widely and, at the same time, a new language and a new alphabetical writing thrived: Aramaic. The latter, a writing that is traced, was well adapted to parchment; whereas the incised cuneiform writing was easier to use on soft surfaces. From the middle of the first millennium and possibly even before this date, Aramaic had become the dominant language in Babylonia. The introduction of Greek in the fourth century only reinforced the use of parchment. Further, it appears that even the exorcists that owned the Urukean private libraries used and spoke Aramaic, certainly as their first language. Nevertheless there was no apparent will to systematically copy the cuneiform texts on parchment[88] and the astronomical documents seem to have been written on clay until the end of the cuneiform tradition.[89]

Be that as it may, the reflections, which have been suggested here, are based on a fundamental aspect of the cuneiform documentation at our disposal: its discovery in situ. This privileged situation allows us to constitute clear corpuses according to place and period. It then becomes possible to consider the evolution of erudite disciplines that may at first seem fixed, but finally show to be in perpetual movement. Further, the analysis of the structure of the collections leads to the reinterpretation of document categories. These documents were first only considered for their contents and thus were separated from their context. Finally, the study of the libraries discovered during well-managed archaeological excavations favours the development of tools. These tools in turn permit the interpretation of the collections discovered in less propitious conditions.

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[88] Concerning this question, cf. (Clancier 2005, 90–1).

[89] Concerning these questions, cf. (Geller 1997). Concerning the last dated or datable cuneiform tablets, cf. (Sachs 1976).

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The Textual Form of Knowledge: Occult Miscellanies in Ancient and Medieval Chinese Manuscripts, Fourth Century B.C. to Tenth Century A.D.

Donald Harper

> *In the +8th came the* Khai-Yuan Chan Ching *already mentioned, and posterity owes a debt of gratitude to its author for preserving so many passages from the ancient writings on astronomy, however astrological his interests may have been.*
>
> (Joseph Needham 1959, 201–2)

In 1900 an itinerant Daoist holy man, Wang Yuanlu 王圓祿, unblocked the entrance to a cave at the Buddhist caves (Mogaoku 莫高窟) near Dunhuang 敦煌, Gansu, revealing a cache of medieval paper manuscripts (scrolls and booklets) that had not been seen since the cave was sealed in the early eleventh century. The cave, numbered Cave 17 in modern Dunhuang studies, appears to have been a manuscript depository used by the local Buddhist establishment before being sealed when the populace of Dunhuang feared an attack by Islamic Karakhanid forces who in 1006 occupied Khotan (west of Dunhuang on the southern edge of the Taklamakan Desert). The manuscripts date from the fifth to tenth centuries A.D. As knowledge of the discovery spread, the Cave 17 manuscripts were dispersed. Major acquisitions by Aurel Stein and Paul Pelliot are now deposited in the British Library and the Bibliothèque nationale de France, respectively.[1] Chinese archaeological excavations since the 1950s are responsible for most ancient manuscripts, written on bamboo- or wood-slips and silk, with tombs of the fourth century B.C. to the first century A.D. providing an especially rich assortment of manuscripts (the number of ancient manuscripts continues to rise with fresh excavations). Excluding a certain

[1] See (Rong 1999–2000) for a history of the manuscript discovery in Cave 17; and (Whitfield 2002, 9–20), which also addresses the issue of forgeries of Dunhuang manuscripts. The numbers assigned to Dunhuang manuscripts in the British Library are preceded by S (for Stein); those in the Bibliothèque nationale de France are preceded by P (for Pelliot).

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F. Bretelle-Establet (ed.), *Looking at It from Asia: The Processes that Shaped the Sources of History of Science*, Boston Studies in the Philosophy of Science 265,
DOI 10.1007/978-90-481-3676-6_2,

number of documents that relate directly to burial practices, the great majority of manuscripts discovered in tombs represent books in circulation among the living which were selected for burial as grave goods.[2]

The manuscript discoveries, ancient and medieval, have great significance for the history of Chinese science. Manuscripts that treat of medicine, astrology, and calendars have received due attention from specialists in these fields.[3] The present chapter focuses on a commonly occurring type of manuscript for which "miscellany" is a convenient label and whose content I characterize as "occult" in the pre-modern European sense of "knowledge or use of agencies of a secret and mysterious nature (as magic, alchemy, astrology, theosophy, and the like)."[4] In ancient and medieval China occult miscellanies would have been regarded as examples of *shushu* 數術 "calculations and arts" literature. The term first appeared in the first century B.C. when it was used in bibliographic classification to designate books on astrology and calendars, on varieties of divination, and on a diverse array of other "occult arts," including physiognomy, demonology, and magic (medical literature was classified separately in the division *fangji* 方技 "recipes and techniques").[5] The relation of *shushu* to forms of knowledge that we might classify as "science" or "natural philosophy" is a question I defer to the conclusion of this chapter, following presentation of evidence from manuscripts and comparison of manuscript evidence to several books that survived the centuries in printed editions.[6] For now, let me just note the family resemblance between "occult" and *shushu* as labels for categories of knowledge in Europe and China in the form of manuscript miscellanies with occult content in vernacular languages in medieval Europe that bear comparison to Chinese *shushu* miscellanies. In particular, the field of *Fachliteratur* or *Sachliteratur* research has refined our understanding of the significance of medieval German occult miscellanies in relation to popular culture (especially among the expanding readership for manuscripts and printed books) and to medieval science.[7]

The twentieth century discovery of Chinese manuscript miscellanies with occult content dating from the fourth century B.C. to the tenth century A.D. allows us to observe the formation of occult ideas and practices and their transmission in manuscripts that to judge from the manuscripts themselves were popular among a readership that we may describe as elite by virtue of

[2] (Giele 1998–1999) provides an overview of ancient Chinese manuscript discoveries as of 1999, arranged by archaeological site; see also (Giele electronic database).

[3] Selected examples of publications in Western languages include (Harper 1998), (Lo and Cullen 2005), (Kalinowski 2003), (Bonnet-Bidaud and Praderie 2004).

[4] *Oxford English Dictionary* (1971). "Miscellany" as a term used in manuscript studies is discussed below, pp. 56–57, nn. 64–65.

[5] See below, p. 40, for details on the first century B.C. bibliographic classification, which served as the basis for the bibliographic treatise in the *Han shu* 漢書.

[6] See (Kalinowski 2003, 110–11) and (Lloyd 2004, 127–28) for discussion of the term *shushu*.

[7] (Crossgrove 1994; Brévart 1988; Eamon 1994).

being literate.[8] This chapter explores two main aspects of the manuscript miscellanies. First is their significance as *realia*—objects produced by copyists and once held by ancient and medieval readers. The manuscripts are not simply sources of information about occult ideas and practices for modern historical analysis. Both in their form and presentation of knowledge the manuscripts influenced ancient and medieval perceptions of that knowledge. Second, the manuscripts allow us to look anew at textual sources deemed most relevant to the history of ancient and medieval Chinese science and to consider fundamental issues regarding the relationship between the knowledge represented by the manuscript miscellanies and the knowledge associated with certain historical figures in modern studies of Chinese science. In the organization of the chapter, presentation of the manuscript miscellanies is first, followed by discussion of three medieval works that have figured prominently in the history of Chinese science: *Wuxing dayi* 五行大義 (Summation of the five agents), compiled by Xiao Ji 蕭吉 (d. 614); *Yisi zhan* 乙巳占 (Yisi-year divination), compiled by Li Chunfeng 李淳風 (602–670); and *Kaiyuan zhanjing* 開元占經 (Divination classic of [the reign] Opened Epoch), compiled by Qutan Xida 瞿曇悉達 (Gautama Siddhartha) and others (date of compilation ca. 714–724).

Manuscript Miscellanies

Before turning to the manuscript miscellanies with occult content let me first review some characteristics of ancient and medieval textual sources most often used in modern studies of Chinese science. Almost without exception, the books have been transmitted in woodblock-printed editions that were published in the post-medieval period—roughly, after the tenth century A.D. In the history of the book in China the tenth century was a time of transition from the book as manuscript to the printed book; the same century brought the end of the Tang dynasty (618–907) and the establishment of the Song dynasty (960–1279). During the Song printing changed the form of the book as well as the patterns for the transmission of texts and written knowledge in books.[9] The survival of transmitted sources in Song printed editions (rare) and in later printings is the result of chance and conscious design; and government sponsored editorial projects frequently determined the selection of books to be printed.[10]

For modern research on the textual sources of ancient and medieval Chinese science there are two practical consequences. First, we use transmitted sources knowing that extant editions probably do not reproduce a book exactly as it

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[8] (Liu Lexian 2003, 14–52) surveys ancient manuscripts. For Dunhuang manuscripts see (Kalinowski 2003). (Yu Xin 2003, 2006) examine Dunhuang occult manuscripts with comparisons to ancient manuscripts.

[9] (Drège 1991, 265–68; Cherniak 1994).

[10] See (Guy 1987) for a detailed history of the compilation of the *Siku quanshu* 四庫全書, commissioned by the Qing court in the eighteenth century.

circulated in ancient and medieval times in manuscripts that are unknown to us. Editorial alterations due to the value attached to it in a later age may obscure our knowledge of the reception and influence of a book in its earlier cultural and intellectual context. The effects of editing and printing are neatly illustrated by the eleventh century Song, government-sponsored woodblock edition of Sun Simo's 孫思邈 seventh century compendium of medical recipes, *Beiji qianjin yaofang* 備急千金要方 (Thousand-in-gold essential recipes in readiness for emergencies). By chance, two incomplete manuscripts of the book have survived that are thought to date to the late Tang or early Song. Although the manuscripts cannot be assigned absolute dates, several types of evidence show that they pre-date editorial changes introduced in the woodblock edition.[11] I note one conspicuous example of editorial change that we may attribute to Song discomfort with Indo-Buddhistic elements that were an integral part of Tang medical knowledge. Both manuscripts preserve the passage describing the method for pounding drugs with mortar and pestle. In the account Buddhist ritual accompanies the drug-pounding procedure: incense is burned before beginning, and after the ingredients are reduced to powder the drug is placed on an altar before an image of the Buddha, followed by an invocation to Buddhist deities and deified patrons of medicine to ensure the efficacy of the drug. The woodblock edition retains the initial instruction to burn incense, but eliminates all subsequent Buddhistic elements.[12]

Second, transmitted sources are a mere fraction of the totality of ancient and medieval books that would be relevant to the history of science had the manuscripts survived. Consider, for example, the bibliographic treatise in Ban Gu's 班固 (32–92) *Han shu* 漢書 (Book of Han), which is based on the catalogue of the Han royal library produced by Liu Xiang 劉向 (79–8 B.C.) and Liu Xin 劉歆 (46 B.C.–A.D. 23). Of 226 titles of books listed in the *shushu* "calculations and arts" and *fangji* "recipes and techniques" divisions of the bibliographic treatise, only two survive in editions that have undergone drastic alteration from Han originals: *Shanhai jing* 山海經 (Classic of mountains and seas) and *Huangdi neijing* 黄帝内經 (Inner classic of the Yellow Thearch).[13] Medieval books listed in contemporary bibliographic records are more numerous, but the number that survived in later printed editions is only slightly better. The lost books have not all disappeared without a trace. Quotations of ancient and medieval sources in medieval compilations such as *Wuxing dayi*, *Yisi zhan*, and *Kaiyuan zhanjing* as well as in encyclopedias and commentaries are invaluable testimony to their content. However, even though a reconstructed text may be fashioned from quotations and other forms of textual testimony, a book cannot again be made whole from text fragments. The reconstructed edition reflects the biases of whoever selected the passages for quotation from the original manuscript book and does not restore the book as it was known to ancient or medieval readers.

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[11] (Wilms 2002, 53–58) summarizes the transmission and editions of *Beiji qianjin yaofang*.

[12] *Zhenben qianjin yaofang* (1996, 630).

[13] *Han shu*, 30.1774 and 1776. See (Harper 1999, 822–23) for further discussion.

The bamboo- or wood-slips and silk of ancient manuscripts are often in poor condition at the time of excavation; and due to disintegration of the binding cords, it may be difficult to determine the original sequence of slips in a manuscript. Some Dunhuang manuscripts were damaged and awaiting repair when stored in Cave 17 and the paper of others deteriorated over the millennium prior to their discovery in 1900. Nevertheless, no matter what their physical condition occult miscellanies are the actual books—or *realia*—used by ancient and medieval readers. Assessing their characteristics as books, the first point to note is that occult miscellanies are unlike books listed in bibliographic records. A book listed by title in a bibliography, and perhaps ascribed to an author or compiler, has achieved a stable identity. Its placement in the classification system of the bibliography further identifies the book with the subdivision of knowledge to which it properly belongs. Perusing book titles in the six subdivisions of the *shushu* "calculations and arts" division in the *Han shu* bibliographic treatise, one has the impression of *shushu* literature neatly classified by specialties, each specialty represented by its own texts. The following five titles are examples: *Jindu yuheng Han wuxing keliu churu* 金度玉衡漢五星客流出入 (Lodgings, progressions, exits, and entrances of the five stars of Han according to the bronze measure and jade transverse), in eight fascicles (*pian* 篇), in the subdivision *tianwen* 天文 "heaven patterns"[14]; *Guo Zhang guan ni yun yu* 國章觀霓雲雨 (Guo Zhang's observations of rainbows, clouds, and rain), in thirty-four scrolls (*juan* 卷), also in *tianwen*[15]; *Feng hou guxu* 風后孤虛 (Lord Wind's orphan-empty system), in twenty scrolls, in the subdivision *wuxing* 五行 "five agents"[16]; *Ti erming zazhan* 嚏耳鳴雜占 (Miscellaneous divination for sneezing and ear-ringing), in sixteen scrolls, in the subdivision *zazhan* 雜占 "miscellaneous divination"[17]; *Zhi buxiang he guiwu* 執不祥劾鬼物 (Seizing the unpropitious and subjugating spectral entities), in eight scrolls, also in *zazhan*.[18]

Among Dunhuang manuscripts there are several examples of occult books with titles that are also recorded in bibliographic records, and one example of a book that is extant in a transmitted edition: *Lingqi jing* 靈棋經 (Classic of numinous counters).[19] As a rule, however, ancient and medieval manuscripts with occult content are miscellanies that collect pieces of textual material according to the plan of the individual who made the manuscript, who might have repeated an arrangement of textual material that recurs in other manuscripts while at times introducing variations. Oral knowledge must have

14 *Han shu*, 30.1764. The five stars are the five naked-eye planets; the bronze measure and jade transverse refer to observational instruments.

15 *Han shu*, 30.1764.

16 *Han shu*, 30.1768 (the orphan-empty system is discussed below, pp. 58–59).

17 *Han shu*, 30.1772.

18 *Han shu*, 30.1772.

19 (Kalinowski 2003, 313–15).

been continually added to the textual mix, but examples of exact or nearly exact text parallels shared between ancient and medieval manuscripts are proof of a fact that may have been assumed implicitly by the medieval elite: the written occult knowledge available to them was an accumulation of material, some of which had been transmitted in writing for over a thousand years as passages were reincorporated into texts and manuscripts of varying content. Textual survival depended on the happenstance of a passage recurring in a variety of texts in multiple manuscript copies over time rather than on the careful and unbroken manuscript transmission of a single text.

Thus, ancient and medieval manuscript miscellanies with occult content attest to the circulation of texts and manuscripts that are mostly unattested in bibliographic records and transmitted sources, yet were part of a manuscript culture that influenced ideas and practices. The roles of compiler, copyist, and reader for miscellanies must have been fluid, with instances of individuals who compiled and copied manuscripts for their own use as well as instances of readers who wanted to acquire the manuscripts. Text parallels indicate that the manuscript miscellanies share textual traditions with transmitted sources such as *Yisi zhan*. The relationship among the manuscripts and between them and transmitted sources shows that compilers of transmitted sources positioned themselves within a shared tradition of knowledge recorded in written texts.

In contrast to *Yisi zhan*, which represents a classified summation of knowledge by a man—Li Chunfeng—who held the position of *taishi* 太史 "grand astrologer-scribe" at the Tang court and was a famous figure in his day, ancient and medieval occult miscellanies were used in everyday circumstances by everyman (chiefly every literate man and woman). Manuscripts are alike in regarding occult agencies as part of everyday reality, whether the activities of spirits, the effects of powers associated with cyclical processes such as *yinyang* 陰陽 and *wuxing* 五行 "five agents," or the manifestation of unusual phenomena. They record knowledge to interpret signs or to respond when the activities of the hidden world affect people, to tap agencies for personal benefit, or perhaps simply to satisfy the curiosity for knowledge. Manuscripts offer a kind of practical knowledge, a reflexive knowledge that gave meaning to individual experience without theoretical elaboration. From the perspective of ancient and medieval manuscript culture, occult miscellanies simultaneously supported and defined the reality of ordinary and unusual events that their content addressed.

Two further aspects of occult miscellanies require comment as background to the testimony of the manuscripts themselves: secrecy and esoteric knowledge, and magico-religious knowledge. Statements occasionally occur in manuscripts that admonish the reader to maintain the secrecy of the text, but they have the appearance of a convention of secrecy rather than a binding injunction.[20] The statements reflect a popularized culture of secrecy shared among the elite who

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[20] See below, p. 66, for a statement on secrecy in P2610.

read and used occult miscellanies: secrecy added value to the knowledge as well as to the manuscript itself as a desirable object because it contained secret knowledge. Nothing about occult miscellanies suggests that their content was esoteric, secret knowledge accessible to initiates who were sworn to secrecy. Nevertheless, a popular concept of secrecy suggests the existence of esoteric traditions that maintain the secrecy of texts. Daoist religion is one such tradition.[21] We might reasonably presume that ancient and medieval specialists in varieties of occult knowledge possessed certain texts that were truly kept secret within a defined group, while other texts circulated among the elite readership for occult literature. Given that specialists themselves played a role in promoting occult literature, the notion of secrecy and its observance would have been inconstant.

My approach to using the terms magic, religion, and magico-religious for research on ancient and medieval China is pragmatic; that is, my concern is to recognize relevant evidence rather than to explain magic and religion.[22] Cults devoted to specific spirits; rituals, sacrifices, incantations, and methods of divination to engage the spirits; specialists, among whom a short list for the ancient period would include *zhu* 祝 "incantor," *bushi* 卜筮 "turtle-shell and milfoil diviners," and *wu* 巫 "spirit medium"—all are indicative of a distinctive sphere of organized magico-religious activity. The medieval organization of Daoist religion and Buddhism makes plausible a further conception of a clergy who ministered to a laity. However, the oldest excavated occult miscellanies of the fourth and third centuries B.C. already attest to a wider sphere of occult ideas and practices that placed religious specialists in the company of other specialists such as astrologers, calendar-makers, physicians, and self-identified specialists whose social prestige depended on the recognition that occult knowledge, broadly defined, was itself a field of knowledge that commanded the notice of society.[23] The manuscripts communicated occult knowledge to an elite readership, and their existence reinforced the status of the knowledge as well as of the specialists whose services remained in demand. The precise accounts in occult miscellanies of incantations and magico-ritual acts to be used in specific circumstances give us a view of what "non-specialists" might do for themselves. Given the paucity of evidence for the activities of the specialists, occult miscellanies are valuable as a representation of magico-religious practices by non-specialists and specialists.

While one effect of the formation of occult knowledge and occult literature was to enrich the lives of the elite readership, another effect was to codify common customs or folk knowledge as part of the same body of written

[21] See (Raz 2004, 262–66) for discussion of medieval Daoist esoteric traditions associated with the *Taishang lingbao wufu xu* 太上靈寶五符序 (Array of the five numinous treasure talismans of the Most High).

[22] See my earlier statements in (Harper 1998, 148–50; Harper 1999, 816–17).

[23] Self-identified specialists include the category of *fangshi* 方士 "recipe gentlemen," first mentioned in Han sources; see (Harper 1999, 818 and 827).

knowledge. For example, one of two third century B.C. occult miscellanies from Zhoujiatai 周家臺 tomb 30, Hubei (described below), gives the method for washing silkworm eggs at dawn, including an incantation whose words are recorded in the manuscript. The same manuscript describes how to ensure that heads of grain ripen to maturity by sprinkling the ash of cooked millet prepared for sacrificial use on the seeds at planting time.[24] Once recorded in manuscripts, oral folk knowledge acquired a further identity as written occult knowledge.

Examples of manuscripts presented below illustrate aspects of occult miscellanies both as *realia* for their original users and as objects of historical investigation for us, including transmission of ancient written occult knowledge as evidenced by text parallels in medieval Dunhuang manuscripts and transmitted sources, the arrangement of texts on manuscripts, the characteristics of occult knowledge as represented in manuscript texts, and the relation of these texts to transmitted sources. The selection is small, encompassing seven ancient manuscripts from four tombs in Hubei and Hunan, and three Dunhuang manuscripts. Collectively, however, I would argue that they are a microcosm of occult knowledge in ancient and medieval manuscript culture. Singly, they speak to the effect of written occult knowledge on the lives of ancient and medieval readers.

Textual Continuity in Ancient and Medieval Manuscripts

I begin with text parallels, selecting passages from three ancient manuscripts in which the exact or nearly exact wording occurs in a Dunhuang manuscript or in a lost work quoted in Qutan Xida's *Kaiyuan zhanjing*. More examples could be given, and examples of similar content demonstrate a broad pattern of textual links between the ancient and medieval manuscripts, but these three manuscripts are proof that written occult knowledge survived due to continual transmission in writing as many people copied occult texts in manuscripts of their own making.

The first example is from one of two bamboo-slip occult miscellanies found in Zhoujiatai tomb 30, Hubei, mentioned above. The tomb was excavated in 1993; the burial is dated ca. 209 B.C. The deceased was male and died in his thirties based on dental analysis. He was a local government official, probably low-ranking.[25] The manuscript consists of seventy-three slips, roughly finished (on some slips the joints of the bamboo have not been scraped smooth), and of varying length and width (between 21.7 and 23 cm long, between 0.4 and 1 cm wide, and between 0.06 and 0.15 cm thick). Graphs on the wider slips are larger

[24] *Guanju Qin Han mu jiandu* (2001, 133–34). The manuscript is discussed below, pp. 44–45 and pp. 57–58.

[25] *Guanju Qin Han mu jiandu*, 145–60.

and the handwriting more cursive than on the narrower slips. The seventy-three slips were found in a pile (the binding cords had disintegrated) underneath two other manuscripts in a basket.[26] Because the manuscript is composed of recipe-like entries, often contained on a single slip, it is not possible to determine the original sequence of slips in the manuscript. The passage below occupies a single, narrower slip, s363. The black mark at the top signifies a new item in the text; the hooks (∟) are text markers, here serving to highlight the listing of four of the five agents[27]:

> ■ 有行而急不得須良日東行越木∟南行越火∟ 西行越金 ∟北行越水毋須良日可也
>
> When travel is urgent and you cannot wait for a good day: when traveling east overcome Wood; when traveling south overcome Fire; when traveling west overcome Metal; when traveling north overcome Water. It is all right to not wait for a good day.

The advice is simple. Travel should normally begin on lucky days (determination of auspicious times for travel, whether departing or returning, is a common topic in occult manuscripts), but when necessary you may resort to the principle of conquest between agents: use a material associated with Metal (west) for travel to the east because Metal conquers the Wood of east; similarly, Water (north) conquers south's Fire, Fire conquers west's Metal, and Earth (center) conquers north's Water. Exactly how the traveler is to overcome the agent of the direction of travel is not explained in the Zhoujiatai manuscript, but is explained in a related passage in a bamboo-slip occult miscellany from Kongjiapo 孔家坡 tomb 8, Hubei, excavated in 2000. A wood-tablet mortuary document in the tomb indicates that the deceased was buried in 142 B.C. and that he was a low-ranking local government official whose personal name was Pi 辟.[28] The Kongjiapo manuscript devotes three slips (s105–107) to the *wu-sheng* 五勝 "five conquerors"—the five agents in their conquest function—and makes explicit what is implicit in the Zhoujiatai manuscript: to travel east, conquer Wood by carrying a piece of iron; to travel south, conquer Fire by carrying a vessel filled with water; to travel north, conquer Water by carrying earth wrapped in cloth; to travel west, conquer Metal by carrying charcoal wrapped in cloth (representing Fire).[29]

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26 *Guanju Qin Han mu jiandu*, 153–56.

27 *Guanju Qin Han mu jiandu*, 133. Reference is by slip (s) numbers or by column (c) numbers for silk manuscripts and Dunhuang manuscripts. For ancient manuscripts I also cite the page of the modern transcription in the published source (plates of the original slips or silk may be consulted using slip or column numbers). For convenience, my transcription in this chapter uses standard modern graphs. For the original forms of many graphs consult the source cited. Lacunae, either because the manuscript is damaged or because graphs are illegible, are indicated with square brackets enclosing the estimated number of missing graphs; [?] means that the number of missing graphs cannot be determined.

28 *Suizhou Kongjiapo Han mu jiandu* (2006, 32–35).

29 *Suizhou Kongjiapo Han mu jiandu*, 140.

The Zhoujiatai manuscript statement about overcoming the five agents recurs over a millennium later in a Dunhuang manuscript (P2661v°), in a section on travel at the end of a text entitled *Zhu zalüe deyao chaozi yiben* 諸雜略得要抄子一本 (Summation of the various miscellanies that obtains their essentials in a single copy)[30]:

> 東行越木南方 越火西方越金北方越水是也
>
> When traveling east overcome Wood; for the south quarter overcome Fire; for the west quarter overcome Metal; for the north quarter overcome Water. This is it.

Except for substituting *fang* 方 "quarter" for *xing* 行 "travel" after the first phrase, the wording is identical to the Zhoujiatai manuscript. The final phrase "This is it" suggests that the information was a well-known formula. The possibility of oral transmission of formulas cannot be excluded, but the Zhoujiatai manuscript is compelling evidence of written transmission for the travel formula.[31]

P2661v° was copied by Yin Anren 尹安仁 on the verso of a paper scroll whose recto is a portion of the ancient dictionary *Erya* 爾雅 (Conforming to refined usage). The scroll itself is notable for being undamaged at both ends (the beginning or the end of an original Dunhuang manuscript scroll is often missing). A colophon on the recto indicates that the manuscript with *Erya* copied on it had been in the possession of a Yin clan member in 774. On the verso Yin Anren identifies himself in the first column as a student at the local school, then writes a blank date formula with the words for "year, month, day, hour" (歲月日時) without recording an actual date. He appears to have copied texts on the verso in the ninth or tenth century. The title *Zhu zalüe deyao chaozi yiben* (Summation of the various miscellanies that obtains their essentials in a single copy) occurs in c31, which applies to the text that occupies the remainder of the verso. The content before c31 is haphazard, more like a writing exercise or draft than a formal copy of a text. Beginning with c31 and *Zhu zalüe deyao chaozi yiben* the remainder of the verso may seem random to the modern eye, but appears to represent Yin Anren's own compilation of material from other occult miscellanies available to him.

The second example is in a bamboo-slip occult manuscript excavated from Wangjiatai 王家臺 tomb 15, Hubei, in 1993 (burial dated mid-third century B.C.). The deceased was probably a local government official. When the tomb was excavated the manuscript was found at the bottom of a stack of five manuscripts. Based on its content the excavators assigned the title *Zaiyi zhan* 災異占 (Divination of calamities and prodigies) to the manuscript. There were two more occult manuscripts in the tomb: a record of milfoil divination and hexagrams different from the *Zhou yi* 周易 (Changes of Zhou) or *Yijing* 易經

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[30] P2661v°, c160. See (Kalinowski 2003, 252–53) for a description of the manuscript.

[31] In transmitted sources the same method is recorded in the fifteenth century Japanese work *Kichinichikō hiden* 吉日考秘傳; see (Nakamura 1985, 435–36).

(Classic of changes); and an occult miscellany.[32] The slips of *Zaiyi zhan* were loose and many were broken because of the pressure of manuscripts and objects placed above; including broken slips, there are eighty-four extant slips.[33] Originally sequential numbers were written at the bottom of slips to organize the separate entries, the highest number on extant slips being 101. However, many numbers between 1 and101 are missing, and because of the poor condition of the slips it is often not possible to associate fragments of a slip-bottom with the text that was written above. As a result, the original sequence of the slips cannot be determined.[34]

Each entry records a prodigious event together with its portentous consequences for humankind. The following three entries match fragments of Jing Fang's 京房 (77–37 B.C.) omenology as quoted in *Kaiyuan zhanjing*. For each Wangjiatai manuscript entry, the corresponding *Kaiyuan zhanjing* quotation is placed underneath:

s94

邦有稾木生邦有大喪
In the state when a withered tree comes to life, there is great mourning in the state.
Kaiyuan zhanjing[35]: 京房易傳曰木枯而 生不及二年國有大喪
Jing Fang's *Changes Commentary* states, "When a tree is withered and comes to life, before two years are up there is great mourning in the state."

s95

邦 有木冬生外入俱亂王國不平
In the state when a tree comes to life in winter, outside and inside are both disordered, and the king and state are not settled.
Kaiyuan zhanjing[36]: 京房曰木冬生王者不平
Jing Fang states, "When a tree comes to life in winter, the king is not settled."

s96

邦 有野獸與邑畜戰於邦朝是謂 [2] 必有它國來 [?]
In the state when wild animals fight the city's domestic animals at the court of the state, this is called…, and invariably there is another state that comes …
Kaiyuan zhanjing[37]: 京房 … 又曰野獸來與家畜鬬有隣國來伐國將亡
Jing Fang … also states, "When wild animals come and combat household domestic animals, there is a neighboring state that comes and attacks, and the state will perish."

The name of Jing Fang and the many works attributed to him—especially occult interpretations of the *Yi* (Changes)—are foundational for five agents,

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[32] (Wang Mingqin 2004, 29–48). For recent discussion of the Wangjiatai divination record, which has been identified as the lost *Guicang* 歸藏, see (Shaughnessy 2006, 156–57; Harper 1999, 857).

[33] (Wang Mingqin 2004, 26–27).

[34] Photographs of the original slips have not yet been published. Chinese transcription in the examples below is based on (Wang Mingqin 2004, 47–48).

[35] *Kaiyuan zhanjing*, 112.4a.

[36] *Kaiyuan zhanjing*, 112.4b.

[37] *Kaiyuan zhanjing*, 116.25a.

yinyang, and *shushu* knowledge beginning from his own lifetime.[38] The Wangjiatai *Zaiyi zhan* provides third century B.C. evidence of textual antecedents to omenological writings associated with Jing Fang in transmitted sources, either in texts that Jing Fang might have compiled or in works later attributed to him. Further, as suggested by the other Wangjiatai occult manuscripts, omenological texts were one of the types of occult literature that circulated in a milieu of literate people who expected the texts to be of use in their everyday life. Jing Fang or textual traditions attached to his name adapted existing occult literature to their purposes, creating new texts while transmitting older written knowledge.

Besides the Jing Fang quotation related to s96, *Kaiyuan zhanjing* quotes the same text parallel from another lost book, the medieval *Dijing* 地鏡 (Earth mirror)[39]:

> 野獸與家畜來鬬他國來伐國
> When wild animals come and combat household domestic animals, another state comes and attacks the state.

The nature of *Dijing* as an omnifarious collection of occult knowledge—a “mirror” revealing knowledge of the world—is discussed below. While we might suppose that *Dijing* relied on Jing Fang textual traditions as its source, given the evidence of the Wangjiatai *Zaiyi zhan* it is equally likely that this piece of written knowledge was simply in circulation in a variety of occult manuscripts when it was incorporated into the *Dijing* that is quoted in *Kaiyuan zhanjing*.

In the first century B.C., Jing Fang was on the cusp of the Han-time appearance of *chenwei* 讖緯 “prophecy and weft-text” literature. The emergence of weft-texts in the first and second centuries A.D. was related to Han court-centered political and ideological developments. Government orthodoxy was already vested textually in *jing* 經 “classics, warp-texts”, defined by the six categories of *jing* identified in the *Han shu* bibliographic treatise.[40] *Wei* “weft-texts” together with *chen* “prophecies” were claimed to be the occult complement to *jing*, revealing esoteric knowledge and promising access to power. The *Hetu* 河圖 (River diagram) and *Luoshu* 洛書 (Luo document), both legendary emblems of divine revelation and political power, were also regarded as *jing* with their associated *wei*. The claims were contested at the time and the status of *chenwei* remained unstable in the centuries after the Han. By the early seventh century the *chenwei* corpus was fragmentary due to decrees by several rulers prohibiting their circulation and ordering destruction of existing copies, culminating with the decree by Thearch Yang of the Sui 隋煬帝 in 604, after which

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38 (Nielsen 2003, 129–32; Loewe 2000, 199–200).

39 *Kaiyuan zhanjing*, 116.25a.

40 *Han shu*, 30.1703–16: *Yi* (Changes), *Shu* 書 (Documents), *Shi* 詩 (Songs), *Li* 禮 (Rites), *Yue* 樂 (Music), *Chunqiu* 春秋 (Spring and autumn).

"their study was not renewed, and even in the secret depository at court [*chenwei*] were mostly scattered and lost."[41]

The third example is an exact text parallel between a second century B.C. manuscript and a *chenwei* text quoted in *Kaiyuan zhanjing*, showing that *chenwei* literature, like Jing Fang textual traditions, incorporated written occult knowledge from older sources such as the newly discovered manuscript. The manuscript is among the silk manuscripts excavated in 1973 from Mawangdui 馬王堆 tomb 3, Hunan (burial dated 168 B.C.). Based on skeletal analysis the deceased was a man in his thirties and was most likely a son of Li Cang 利蒼, whom archaeologists can identify with certainty as the man buried in Mawangdui tomb 2. Li Cang was an aristocrat and chancellor in the Kingdom of Changsha 長沙國 under the Han dynasty. According to historical sources, one son, Li Xi 利豨, succeeded to his father's aristocratic title.[42] Mawangdui tomb 3 manuscripts are famous for two copies of a work in two parts entitled *De* 德 and *Dao* 道 respectively, and known to us with the parts reversed as *Daode jing* 道德經 (Classic of way and power) or *Laozi* 老子 (*De* and *Dao* are written as end titles in the second, younger copy from Mawangdui). Forty-eight texts from Mawangdui are unknown in received editions, ranging from philosophical and historical writings to works on medicine, astrology, and horse physiognomy. As with the Wangjiatai manuscripts, Mawangdui manuscripts include writings that someone not a medical or *shushu* specialist by occupation might have possessed.[43]

Two Mawangdui occult manuscripts are copies of the same pair of texts, but in a different arrangement on the silk. There are no titles on the original manuscripts. The first text concerns a system called *xingde* 刑德 "punishment and virtue," an astro-calendrical method to calculate lucky and unlucky times and positions. Two diagrams are drawn above the text. The text with accompanying diagrams has been designated *Xingde* A on the first manuscript and *Xingde* B on the second manuscript.[44] The main content of the second text treats of the sun, moon, wind, rain, clouds, and vapors, whence the title assigned to it by Liu Lexian, *Riyue fengyu yunqi zhan* 日月風雨雲氣占 (Divination of sun, moon, wind, rain, clouds, and vapors), distinguishing between copy A on the first manuscript and copy B on the second manuscript.[45] The first manuscript is

[41] *Sui shu*, 32.941 (from the account of *wei* "weft-texts" following the subdivision of the *Sui shu* bibliographic treatise devoted to them). (Yasui and Nakamura 1966, 260–64), summarizes historical records of prohibitions of *chenwei*; (ibid. 356–71) is a table of weft-texts for which textual fragments have survived in transmitted sources. For background on *chenwei*, see also (Dull 1966; Seidel 1983, 291–323).

[42] There has been disagreement over the identity of the deceased in Mawangdui tomb 3. For various arguments and summary of evidence that the deceased was Li Xi, see (Fu Juyou 2004).

[43] See the summary of silk manuscripts in *Changsha Mawangdui er san hao Han mu* (2004, 87–91).

[44] See (Kalinowski 1998–1999) for a study of the *Xingde* texts.

[45] (Liu Lexian 2003a, 7–8 and 17–18).

somewhat older than the second, copied as early as the beginning of the second century B.C.; the second manuscript can be no later than 168 B.C.[46] On the first manuscript, *Riyue fengyu yunqi zhan* A occupies the right side and *Xingde* A occupies the left side of the sheet of silk; the order is reversed on the second manuscript, *Riyue fengyu yunqi zhan* B on the left and *Xingde* B on the right. The third example is transcribed from *Riyue fengyu yunqi zhan* A[47]:

月七日不弦主人將死
On the seventh day of the month the moon does not form a strung bow. The ruler will die.

Compare the corresponding passage in the weft-text *Hetu dilan xi* 河圖帝覽嬉 (River diagram: Thearch gazing with delight) from *Kaiyuan zhanjing*[48]:

月十日不弦以戰不勝主將死
On the tenth day of the month the moon does not form a strung bow. In battle there is not victory and the ruler will die.

The passage concerns the waxing moon, with the seventh day marking the crescent or "strung bow" phase. Errors involving the graphs *qi* 七 "seven" and *shi* 十 "ten" are frequent in manuscripts. In this case the Mawangdui text can be used to emend the *Kaiyuan zhanjing* quotation.

Liu Lexian documents more examples of content related to astrology and celestial phenomena that is shared between ancient occult manuscripts and fragments of *Hetu dilan xi*, other weft-texts, and occult sources quoted in *Kaiyuan zhanjing* and *Yisi zhan*.[49] In the case of *Hetu dilan xi*, all of the 311 extant fragments concern astrology and celestial phenomena and all but twenty-seven fragments are quotations in *Kaiyuan zhanjing*.[50] Fragments of other *Hetu* weft-texts preserved in other transmitted sources attest to content that probably occurred in *Hetu dilan xi*—including accounts of the revelation of the *Hetu*—but because the *Kaiyuan zhanjing* compilers did not select this kind of material and because few other transmitted sources quote *Hetu dilan xi*, the selectiveness of the *Kaiyuan zhanjing* compilers has determined what we know of its content. For us, their selectiveness highlights the influence of earlier occult literature, as evidenced by the manuscripts, on the formation of *chenwei* literature. For ancient and medieval readers, the most obvious difference between the more popular occult manuscripts and *chenwei* literature would have been the prestige of the latter based on the association of *wei* "weft-texts" with *jing*

[46] (Liu Lexian 2003a, 20).

[47] I follow the transcription in (Liu Lexian 2003a, 161–62). I have benefited from the translation of *Riyue fengyu yunqi zhan* by Ethan Harkness, doctoral student at the University of Chicago (Harkness 2007). Harkness notes the specific denotation "defender" for *zhuren* 主人 in ancient Chinese military terminology (contrasting with *ke* 客 "attacker").

[48] *Kaiyuan zhanjing*, 11.14b.

[49] (Liu Lexian 2003, 341–51); (Liu Lexian 2003a, 29–194) transcribes three Mawangdui *shushu* texts and identifies parallels with received sources in the annotation.

[50] (Yasui and Nakamura 1971–1992, 6:54–85).

"classics." Despite government prohibitions, compilers of medieval works such as *Kaiyuan zhanjing* and *Yisi zhan* regarded *chenwei* sources as authoritative in ways that occult manuscripts were not. Nevertheless, they knew what is apparent to us: that *chenwei* literature shared occult content with those manuscripts.

A passage in Yin Anren's *Zhu zalüe deyao chaozi yiben* demonstrates medieval awareness of the relationship between the two kinds of occult sources[51]:

> 以太歲日懸 虎頭戶上令子孫孝壽宜官位. 一經云虎鼻吉.
> On the great-year day[52] hanging a tiger head over the doorway makes sons and grandsons filial and long-lived and is conducive to obtaining office. One *Classic* states: Tiger nose is auspicious.

The unnamed *jing* "classic" is probably the *wei* "weft-text" *Longyu hetu* 龍魚河圖 (Dragon-fish river diagram), as quoted in a Song encyclopedia[53]:

> 懸文虎鼻門上宜官子孫帶印綬. 懸虎鼻門中周一年取燒作屑與婦飲之. 二月中便兒生貴子. 勿令人知之. 泄則不驗也. 亦勿令婦人見之.
> Hanging a patterned-tiger nose over the doorway is conducive to obtaining office, and sons and grandsons will wear the seal and sash. Hang a tiger nose in the doorway for an entire year, incinerate and reduce to fine flakes, and have the woman drink it. In the second month there will be a son who at birth will be noble. Do not let others know of it; if divulged, verification does not occur. Also do not let the woman observe it.

Longyu hetu quotations occur in a variety of transmitted sources, and their content ranges from mythology and astrology to popular occult lore. The tiger-nose passage reads like occult recipes in manuscripts and transmitted sources, including the instructions for preparation of magical substances and the injunction to act in secret lest their efficacy is lost. In P2661v°, the *Longyu hetu* "tiger nose" is identified as an alternative to Yin Anren's main textual source which stipulates "tiger head." Reference to the "classic" validates the practice of using a tiger head without making an issue of the textual authority of *jing* and *chenwei*. There are other examples of popular occult lore shared between P2661v° and *Longyu hetu* fragments, but they are not explicitly noted by Yin Anren. Moreover, the same lore is quoted in other medieval transmitted sources, which may identify a text other than *Longyu hetu* as the source. As pieces of written occult knowledge the shared passages were not defined by their association with a particular text.[54]

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[51] P2661v°, c54.

[52] Taisui *ri* 太歲日 "great-year day" is the first day of the first lunar month; that is, New Year's Day (Tan Chanxue 1998, 64).

[53] *Taiping yulan* (1997, 891.3b); (Yasui and Nakamura 1971–1992, 6:96).

[54] For example, P2661v°, c95, on burying silkworm detritus in the house for good luck, corresponds to *Longyu hetu* (Yasui and Nakamura 1971–1992, 6:95). The *Longyu hetu* fragment was preserved in the sixth century agricultural book *Qimin yaoshu* 齊要術 (Everyman's essential arts). The tenth century Japanese medical compendium *Ishinpō* (1994, 26.554), describes the same method but identifies the source as *Zhenzhong fang* 枕中方 (Recipes from inside the headrest).

I offer a single example of similar content to demonstrate textual links between ancient and medieval occult manuscripts that perpetuated occult ideas and practices. An ancient incantation to be chanted after experiencing a nightmare, recorded in two third century B.C. bamboo-slip occult miscellanies from Shuihudi 睡虎地 tomb 11, Hubei (burial dated ca. 217 B.C.), has a counterpart in the Dunhuang manuscript P2682r◦, a medieval demonographic text entitled *Baize jingguai tu* 白澤精怪圖 (White Marsh's diagrams of spectral prodigies). Shuihudi tomb 11 was excavated in 1975. The deceased was a government official, personal name Xi 喜, who probably died at the age of forty-six *sui* 歲.[55] The second Shuihudi manuscript has the title *Rishu* 日書 "day book" written on a slip at the end, and has been designated *Rishu* B; the first manuscript, whose content is related but is untitled, is referred to as *Rishu* A. Shuihudi *Rishu* A and *Rishu* B include sections on astro-calendrical, hemerological, and magico-religious matters, but they are not identical texts. Examples of this type of occult miscellany have been discovered in many ancient tombs, and *rishu* "day book" has become the name applied to manuscripts that appear to fit the type (of manuscripts mentioned above, occult miscellanies from Zhoujiatai, Wangjiatai, and Kongjiapo have been identified as *rishu*). *Rishu* manuscripts from fourth to first century B.C. tombs, whose occupants range from ordinary government office-holders to high officials and aristocrats, show that *rishu* are distinctive collections of shared occult material, not different copies of the same book; the hand of the compiler is evident in each manuscript. Moreover, their content reflects a concern for the welfare of the household and oneself.[56]

In Shuihudi *Rishu* A the heading "Meng" 夢 (Dream) is written at the top of the first of the two slips with the nightmare incantation, which is the only content of the section (s13–14v◦)[57]:

> 人有惡夢乃繹髮西北面禱之曰皋敢告爾[illegible]某有惡夢走 歸[illegible]之所[illegible]強 飲 強 食 賜 某大幅 非 錢 乃布 非 繭乃絮則止矣
>
> When a person has foul dreams, on wakening then unbind the hair, sit facing the northwest and chant this prayer: "Heigh! I dare to declare you to Qinqi. So-and-so has had foul dreams. Flee back home to the place of Qinqi. Qinqi, drink heartily, eat heartily. Grant so-and-so great broadcloth.[58] If not coins, then cloth. If not cocoons, then silkstuff." Then it will stop.

The idea behind the *dao* 禱 "prayer" (specifically, an incantation promising offerings to spirits in anticipation of receiving their favor) is that a nightmare is a form of demonic attack and that the incantation counteracts harmful consequences of the attack. The verbal action (the incantation) is accompanied by ritual action (unbound hair and direction of sitting position). We learn from the

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[55] *Shuihudi Qin mu zhujian*, 1–2.

[56] See the survey of *rishu* in (Liu Lexian 2003, 27–38).

[57] *Shuihudi Qin mu zhujian*, 210.

[58] No doubt *fu* 幅 "broadcloth" puns with *fu* 福 "blessings" and *fu* 富 "wealth."

incantation that Qinqi 矜琦 is the spirit world overseer of nightmare demons, hence the words of the incantation summon Qinqi and command the demons to return to Qinqi's supervision. Simultaneously, the person chanting the incantation (represented in the text by "so-and-so," replaced by the person's name when chanting) offers sacrificial drink and food to Qinqi and requests material blessings in return.

In *Rishu* B the nightmare incantation is written on the last two slips of a section occupying seven slips, with the heading "Meng" (Dream) written at the top of the second slip of the section.[59] The first five slips of the section describe a system of dream divination based on five kinds of dream (mainly associated with colors) and on the day the dream occurs according to the ten *tiangan* 天干 "heaven stems" of the sexagenary day-counting cycle (Table 1). In the incantation, the spirit overseer of nightmare demons is named Wanqi 宛奇, not Qinqi. Besides the different names, there are differences in wording between the two manuscripts in the phrases preceding the incantation and in the incantation itself. The two Shuihudi *Rishu* have the same content but in different written versions.

Here is the related medieval text from P2682r°, c80–82:

Table 1 Stems and Branches, and the Sexagenary Cycle

Stems				Branches			
s1	甲 *jia*	s6	己 *ji*	b1	子 *zi*	b7	午 *wu*
s2	乙 *yi*	s7	庚 *geng*	b2	丑 *chou*	b8	未 *wei*
s3	丙 *bing*	s8	辛 *xin*	b3	寅 *yin*	b9	申 *shen*
s4	丁 *ding*	s9	壬 *ren*	b4	卯 *mao*	b10	酉 *you*
s5	戊 *wu*	s10	癸 *gui*	b5	辰 *chen*	b11	戌 *xu*
				b6	巳 *si*	b12	亥 *hai*

The sexagenary cycle in numerical notation

n1–10:	s1-b1 甲子	s2-b2 乙丑	s3-b3 丙寅	s4-b4 丁卯	s5-b5 戊辰	s6-b6 己巳	s7-b7 庚午	s8-b8 辛未	s9-b9 壬申	s10-b10 癸酉
n11–20:	s1-b11 甲戌	s2-b12 乙亥	s3-b1 丙子	s4-b2 丁丑	s5-b3 戊寅	s6-b4 己卯	s7-b5 庚辰	s8-b6 辛巳	s9-b7 壬午	s10-b8 癸未
n21–30:	s1-b9 甲申	s2-b10 乙酉	s3-b11 丙戌	s4-b12 丁亥	s5-b1 戊子	s6-b2 己丑	s7-b3 庚寅	s8-b4 辛卯	s9-b5 壬辰	s10-b6 癸巳
n31–40:	s1-b7 甲午	s2-b8 乙未	s3-b9 丙申	s4-b10 丁酉	s5-b11 戊戌	s6-b12 己亥	s7-b1 庚子	s8-b2 辛丑	s9-b3 壬寅	s10-b4 癸卯
n41–50:	s1-b5 甲辰	s2-b6 乙巳	s3-b7 丙午	s4-b8 丁未	s5-b9 戊申	s6-b10 己酉	s7-b11 庚戌	s8-b12 辛亥	s9-b1 壬子	s10-b2 癸丑
n51–60:	s1-b3 甲寅	s2-b4 乙卯	s3-b5 丙辰	s4-b6 丁巳	s5-b7 戊午	s6-b8 己未	s7-b9 庚申	s8-b10 辛酉	s9-b11 壬戌	s10-b12 癸亥

[59] *Shuihudi Qin mu zhujian*, 247 (s189–195).

> 人夜得惡夢旦起於舍東北被髮呪曰伯奇伯奇不飲酒食肉食高興地其惡夢歸於伯奇厭夢息興大福如此七呪無咎也
> When a person has foul dreams at night, rise at dawn, and in the northeast part of the house unbind the hair and chant this incantation: "Boqi, Boqi. He does not drink ale or eat meat, and regularly eats the earth of High Elevation. May these foul dreams return home to Boqi. Crushing dreams cease, give rise to great blessings." Chant the incantation like this seven times and there will not be spirit odium.

P2682r° is an example of a popular medieval demonographic genre associated with Baize (White Marsh), identified in transmitted sources as a spirit protector who revealed the name and identity of all spirit creatures and demonic hazards to the Yellow Thearch 黃帝 for the benefit of humankind.[60] The title *Baize tu* (White Marsh's diagrams) is listed in medieval bibliographic records and fragments attributed to the book are quoted in transmitted sources, but only P2682r° shows us a copy of the actual book. Most of the scroll is missing. The title *Baize jingguai tu* is written in the last column of text, followed by the statement that forty-one sheets of paper were used to make the scroll; P2682r° preserves only the last seven sheets. The copyist identifies himself in the penultimate column. He is a Buddhist monk, Daoxin 道昕, secular surname Fan 范, and he writes that he has copied the manuscript for use by Daoists and Buddhist monks. As the only surviving example, we cannot know the relation of P2682r° to other manuscript copies of a *Baize tu* that were in circulation (I discuss below the probability that *Baize tu* was a generic title for a type of medieval occult miscellany, whose content varied from one copy to the next).

The original scroll of *Baize jingguai tu* was mostly composed of separate entries on demonic and unusual phenomena in which a written statement identifying the phenomenon is followed by a drawing of it. The nightmare incantation occurs in the text-only portion at the end of P2682r°, where it is the last of four entries on ominous things that occur in the household at night. Neither these entries nor those before and after are formally arranged in sections with headings; rather, the text is written in continuous columns with a blank space between entries. The other entries are a mixture of occult information regarding demonic and unusual phenomena, including divining the meaning of noises emitted by cooking vessels on the kitchen stove. Some of the information occurs in other Dunhuang occult miscellanies and in transmitted sources, showing the medieval circulation of written occult knowledge. An ancient antecedent to this type of text occurs in a section of Shuihudi *Rishu* A that comes shortly after the nightmare incantation. Under the heading "Jie" 詰 (Spellbinding) there are approximately seventy entries that describe demonic phenomena and provide a remedy for each one. Correspondences with the Dunhuang *Baize jingguai tu* include similar content as well as idiomatic expressions that are typical of the demonographic genre.[61]

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[60] See (Kalinowski 2003, 455–58) for a description of the manuscript. S6261 is a fragment of the same manuscript (Kalinowski 2003, 467).

[61] *Shuihudi Qin mu zhujian*, 212–19 (24–68v°); (Harper 1985).

Let me note the similarities between the Dunhuang *Baize jingguai tu* nightmare incantation and the Shuihudi *Rishu* A incantation: the same ritual action precedes the incantation (but facing northeast in the medieval text rather than northwest); the name for the overseer of nightmare demons is related (Boqi in the medieval text, Qinqi in the ancient text); both incantations summon the overseer and command the demons to return to his supervision; both incantations request blessings from the overseer. Most remarkable is the evident identity between Boqi as the medieval name for the spirit known in the third century B.C. as Qinqi in the *Rishu* A incantation and as Wanqi in the corresponding *Rishu* B incantation. Boqi is attested in the *Hou Han shu* 後漢書 (Book of Later Han) treatise on ritual as the name of the spirit who "eats dreams." The reference occurs in the words of the curse chanted during the *danuo* 大儺 exorcism conducted on the last day of the year at the Han court, in which Boqi is one of twelve spirits summoned to eradicate demons.[62]

There is no direct textual relation between the curse text in the *Hou Han shu* and the nightmare incantations in the Shuihudi and Dunhuang occult manuscripts. The close relation between the P2682r° nightmare incantation and the *Rishu* A incantation indicates that the Dunhuang *Baize jingguai tu* is a medieval record of a popular magico-religious practice that had been continually transmitted in writing since the third century B.C. Precisely when the name Boqi for the overseer of nightmare demons became current is not clear; perhaps new discoveries of ancient occult manuscripts will provide attestation.[63]

Form and Function of Manuscript Miscellanies

The choice of texts and their arrangement on manuscript miscellanies offer another perspective on the circulation of written occult knowledge. I noted above the prevalence among ancient and medieval manuscripts of occult miscellanies with multiple texts variously combined, the rarity of single-text manuscripts that might or might not identify the text by title, the overlapping roles of compiler, copyist, and reader, and the practice of individuals producing manuscripts for personal use. The title that Yin Anren wrote in P2661v°, c. 31, *Zhu zalüe deyao chaozi yiben* (Summation of the various miscellanies that obtains their essentials in a single copy), exemplifies a medieval conception of a manuscript miscellany for the makers and users. The title announced that within a single manuscript was an "essential summation of miscellanies" known to Yin Anren. As used by Yin Anren, *za* 雜 "mixture, blend, miscellany" had a positive

[62] *Hou Han shu*, treatise 5, 3128; (Harper 1988, 74).

[63] See (Harper 1988) for further discussion. The ancient and medieval manuscript evidence eliminates one conjecture: that a medieval nightmare incantation adopted the name Boqi from the text of a curse used during the year-end exorcism at the Han court (it is more likely that the curse recorded in the *Hou Han shu* shows the influence of popular occult ideas and practices as recorded in manuscripts).

connotation that is confirmed by the occurrence of *za* in book titles recorded in ancient and medieval bibliographic records.[64]

My use of "miscellany" for a type of ancient and medieval Chinese manuscript in part translates *za* and in part follows use of "miscellany" as a term in European manuscript studies, where its utility as a label for a common manuscript type is simultaneously criticized. Chiefly, "miscellany" in modern usage suggests a disorganized product, whereas pre-modern European manuscripts described as miscellanies can be shown to have a definite idea of order in the compiler's choice of textual material and in the reader's expectation.[65] By examining the choice of texts and their arrangement on ancient and medieval Chinese occult miscellanies we observe how the knowledge was organized in a manuscript that also had a practical function for readers. Occult miscellanies were how most readers acquired their knowledge, and the manuscripts shaped their perception of occult ideas and practices. In contrast to the classification of occult knowledge represented by the *shushu* "calculations and arts" division of the *Han shu* bibliographic treatise and subsequent bibliographic records, or by the content of a work such as *Kaiyuan zhanjing*, occult miscellanies offer us a literate everyman's view of the organization of occult knowledge in manuscripts that ancient and medieval readers actually used. Even when the content of an occult miscellany is appropriately described as random, we are better informed of the textual exchange of knowledge as part of broad social, cultural, and intellectual patterns.

I offer brief accounts of three manuscripts as a sample of occult miscellanies, two ancient and one medieval: the two Zhoujiatai occult manuscripts and P2610. A full survey of relevant manuscripts would include examples of manuscripts with a single occult text, examples of distinctive miscellany types (such as ancient *rishu* "day book" manuscripts), manuscripts that combine occult texts with medical texts, and medical texts whose content includes occult material that occurs in manuscript miscellanies.[66] All are evidence of the ease with which written occult knowledge was incorporated into a variety of manuscripts and they illustrate textual relations among fields of knowledge. Another feature of Dunhuang occult manuscripts was the practice of copying texts on the blank verso of a paper scroll whose recto already contained other, often well known writings, as in the case of Yin Anren's occult miscellany on the verso of a manuscript with a portion of the *Erya* on the recto. Except to remark that

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[64] See n. 17 above for one title in the *Han shu* bibliographic treatise, in the *zazhan* subdivision of the *shushu* division. There are more examples in the *tianwen* subdivision, *Han shu*, 30.1764. See *Sui shu*, 34.1019–21, for examples of medieval titles with *za* in the *tianwen* subdivision of the *Sui shu* bibliographic treatise. The occurrence of *za* in titles is fairly common in titles in other divisions of both bibliographic treatises.

[65] (Nichols and Wenzel 1996, 3–4).

[66] For discussion of occult material in ancient medical manuscripts, see (Harper 1998, 159–72); (ibid., 354–55) is the translation of a section of magical recipes for traveling from a Mawangdui medical recipe manual. S5614 is an example of a medieval booklet in which four medical texts are copied with astrological and cleromantic texts (Kalinowski 2003, 78 and 352–53).

Yin Anren wrote on the blank verso because it was there, why ancient and medieval copyists used the space of a manuscript as they did cannot be fully explained by the manuscript itself (even in occasional colophons); yet every manuscript is a material witness to the circumstances of its production. Discussion of the Zhoujiatai manuscripts and P2610 allows me to raise several general issues related to manuscript production while at the same time speculating on the perception of these manuscripts by their ancient and medieval readers.

One of the Zhoujiatai occult miscellanies has been mentioned above for the entry on travel and the conquest sequence of the five agents (s363). The modern editors were unable to determine the original sequence of the manuscript's seventy-three slips (numbered s309–381 for publication). The editors made the current arrangement of the recipe-like entries, placing thirty-eight slips with eighteen medical recipes at the beginning (s309–346) followed by other content, and they assigned the title *Bingfang ji qita* 病方及其它 (Ailment recipes and other matters).[67] While we do not have an exact reconstruction of the original manuscript, the bamboo slips and their content may be analyzed as evidence of an occult miscellany made for personal use; it is not implausible that the man buried in Zhoujiatai tomb 30 made the manuscript.

Text was copied onto the slips before they were bound (in contrast, the other Zhoujiatai occult miscellany was made by first binding slips to form a continuous, blank surface to receive text and diagrams). Roughly finished slips, slips of different sizes bound together, and different handwriting on the narrower and wider slips all suggest hasty, informal manuscript production. Discontinuous content on some slips may be the result of slips that disintegrated without leaving a trace over the centuries inside the tomb.[68] However, it is also possible that slips were already missing from the bound manuscript when it was placed in the tomb. Given differences in slip size and handwriting, we might suppose several people were involved in copying written occult knowledge onto slips that were consolidated into a single, bound manuscript—and that slips might have been omitted at the final stage of manuscript production. Alternatively, the manuscript might have been made by removing slips from other bound manuscripts and re-combining them (perhaps together with newly copied slips) to make the manuscript we have. Either scenario suggests a production process adapted to personal use. The personal element is reinforced by one slip (s364) that records travel by an unnamed official to a place called Wan 宛 during the seventh and eighth months of an unspecified year, but that might correspond to the thirty-sixth year (211 B.C.) or thirty-seventh year (210 B.C.) of the First Qin August Thearch 秦始皇帝 based on calendars for those years discovered among the Zhoujiatai tomb 30 manuscripts.[69] Might the official have been the deceased? Or perhaps he was a member of this official's staff?

[67] *Guanju Qin Han mu jiandu*, 126–37.

[68] For example, it is clear from the content of s365 that slip(s) before it are missing.

[69] *Guanju Qin Han mu jiandu*, 99–102. Slip s364 specifies three days in the seventh month and one day in the eighth month using sexagenary signs, and the signs coincide with days in those months during either the thirty-sixth or thirty-seventh year.

Among the medical recipes, ten use drugs (s309–325) and eight detail magico-religious practices (s326–346). The remaining entries mainly concern astro-calendrical, hemerological, and magico-religious methods that have practical value in daily life, but they include recipes to eliminate rats with an arsenic preparation and to fatten cattle. From the standpoint of manuscript production and content, s355–362 are noteworthy (Fig. 1).[70] The first six slips (s355–360) are wide and roughly finished (the bamboo joints were not smoothed) with large, cursive handwriting. The slips explain the *guxu* 孤虛 "orphan-empty" system, which is based on the sexagenary cycle of the ten *tiangan* "heaven stem" and twelve *dizhi* 地支 "earth branch" signs divided into six decades of days (Table 1): s355, *jiazi xun* 甲子旬 "*jiazi* decade" (days 1–10); s356, *jiaxu xun* 甲戌旬 "*jiaxu* decade"



Fig. 1 Zhoujiatai *guxu* "orphan-empty" system, s355–362

[70] *Guanju Qin Han mu jiandu*, 133.

(days 11–20); s357, *jiashen xun* 甲申旬 "*jiashen* decade" (days 21–30); s358, *jiawu xun* 甲午旬 "*jiawu* decade" (days 31–40); s359, *jiachen xun* 甲辰旬 "*jiachen* decade" (days 41–50); s360, *jiayin xun* 甲寅旬 "*jiayin* decade" (days 51–60). In each decade ten stems combine with ten branches, and the two branches that do not combine with stems are *gu* "orphans"; the two branches in the middle of each decade are in opposition to the "orphan" branches and are *xu* "empty." The final two slips (s361–362) are narrower slips with smaller, less cursive handwriting, and they concern the application of the *guxu* system to finding lost horses and cattle: in each decade the lost animals should be hunted in the "orphan" direction (Table 2). The eight slips are the oldest full account of the *guxu* system together with an application. They form an entire unit of written occult knowledge, but are a combination of two kinds of slips with different handwriting.

The bamboo slips of the other Zhoujiatai occult miscellany were found at the top of the basket of manuscripts. The slips are 29.3–29.6 cm long, 0.5–0.7 cm wide, and 0.08–0.09 cm thick. On the back side of each slip the bottom 1–2 mm is scraped away to make a slanted end that exposes the yellow part of the bamboo. Although the binding cords had disintegrated, the distinctive slanted-end and the position of the slips at the time of excavation indicate that the 241 slips formed one manuscript that was rolled so that the beginning was at the center of the bundle.[71] Using the numbering of slips assigned by the modern editors for publication, the original occult miscellany begins with s131–308 and continues with s69–130. The slips at the beginning (s131–308) are identified by the modern editors as a miscellany of the *rishu* type; the slips at the end (s69–130) are a calendar for the thirty-sixth and thirty-seventh years in the reign of the First Qin August Thearch (211 and 210 B.C.). In the published numbering the calendar slips precede the *rishu* slips because of the editors' decision to classify the bamboo slips by main content. They separated the thirty-sixth and thirty-seventh year calendar (s69–130) from the *rishu* (s131–308) and arranged it ahead of the *rishu* in a separate

Table 2 Zhoujiatai *guxu* "orphan-empty" system, s355–362

Decade	Orphan branches	Empty branches	Orphan direction
jiazi 甲子	*xu* 戌, *hai* 亥	*chen* 辰, *si* 巳	Northwest
jiaxu 甲戌	*shen* 申, *you* 酉	*yin* 寅, *mao* 卯	West
jiashen 甲申	*wu* 午, *wei* 未	*zi* 子, *chou* 丑	south
jiawu 甲午	*chen* 辰, *si* 巳	*xu* 戌, *hai* 亥	southeast
*jiachen*甲辰	*yin* 寅, *mao* 卯	*shen* 申, *you* 酉	east
jiayin 甲寅	*zi* 子, *chou* 丑	*wu* 午, *wei* 未	north

[71] *Guanju Qin Han mu jiandu*, 154. The excavation report does not state that the slanted bottom end is on the back side of each slip. I am grateful to Peng Hao 彭浩 for personally examining the original bamboo slips and reporting to me the result of his examination (according to Peng Hao, it is no longer easy to see the slanted end on all slips, and in some cases the bottom of the slip is missing).

category for calendars, where it follows a bamboo-slip calendar for the thirty-fourth year (213 B.C.) found in the same basket (s1–68). A third calendar corresponding to the year 209 B.C. on a wood tablet found near the basket (the basis for the estimated date of burial) is published with the two bamboo-slip calendars.[72]

To my knowledge the Zhoujiatai occult miscellany is the oldest example of both *rishu* and calendar combined in one manuscript. As evidenced in manuscript discoveries, ancient *rishu* generally detail astro-calendrical and hemerological systems but leave the user to make the correlations with the calendar for the year in question (especially important as regards the stem and branch cycle signs for months and days in a given year, which are necessary for many *rishu* systems). The Zhoujiatai manuscript conveniently includes the calendar for the thirty-sixth and thirty-seventh years, and one of the *rishu* systems also identifies five agent correspondences for the thirty-sixth year (s297–302).[73] The rarity of combining *rishu* and calendar may indicate a preference for circulating written knowledge of *rishu* systems in manuscripts that did not become dated with the change of years. Medieval calendars from Dunhuang represent the later development of an almanac format combining the specifics of a calendar year with useful astro-calendrical and hemerological information.[74]

Among ancient *rishu* discovered to date the *rishu* part of the Zhoujiatai occult miscellany is an unusual example. Bamboo slips were first bound with cords to make a smooth surface to receive text and diagrams. A large circular diagram on the upper half of s156–181 correlates stems, branches, agents, spatial directions, and times of day with the celestial ring of twenty-eight *xiu* 宿 "stellar lodges." The diagram was drawn first, followed by text on either side of the diagram. When copying the text to the right of the diagram—a list of months and the stellar lodges attached to each month according to a fixed astro-calendrical system, beginning with the eighth month at the top of s131—the copyist ran out of space. For each month heading, one stellar lodge name is written under the month and subsequent stellar lodge names for that month are written on separate slips to the left across the first register of s131–154 (some months have two associated stellar lodges, others have three). For the eighth month, Horn (*jiao* 角) is written on s131 and Gullet (*kang* 亢) is on s132. Twenty-eight slips would have been needed to complete the list in this format on the first register, but there are only twenty-five slips before the circular diagram (s131–155). The copyist chose to stop on s154, recording the sixth month and the stellar lodge Willow (*liu* 柳), then completed the list in a second register beginning back on s131 with the second stellar lodge for the sixth month, Seven Stars (*qixing* 七星), and finishing with the seventh month on s132–134, second register (Fig. 2).

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72 For transcription of the calendars, see *Guanju Qin Han mu jiandu*, 93–104; for the *rishu*, see 104–26.

73 *Guanju Qin Han mu jiandu*, 125.

74 (Kalinowski 2003, 85–211).

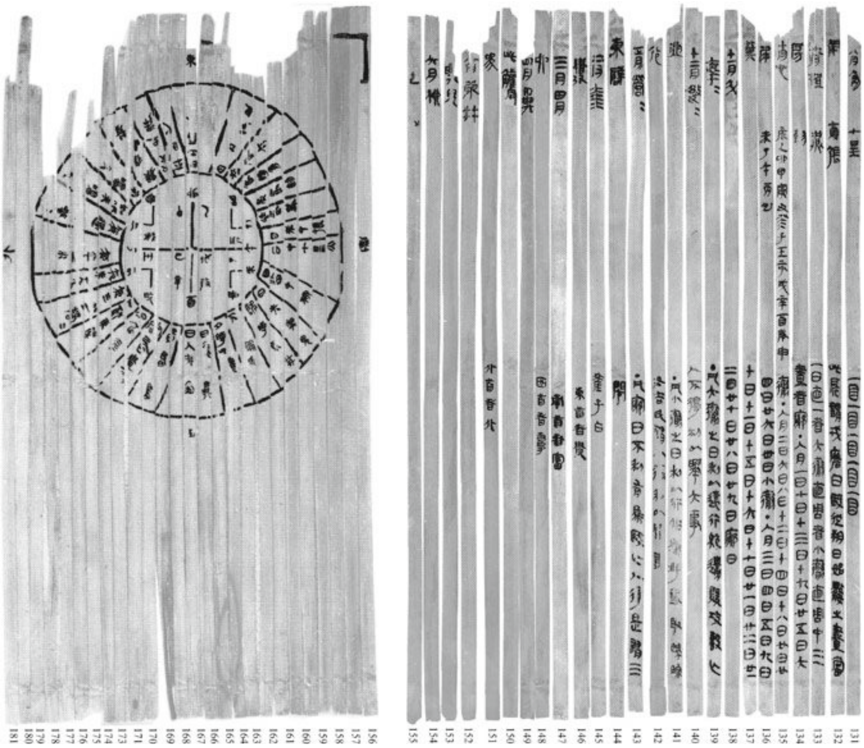


Fig. 2 Zhoujiatai *rishu*, s131–181

To the left of the circular diagram, it appears that the copyist left five blank slips (based on the position of the blank slips in the loose stack at the time of excavation), then used the next fifty-six slips (s187–242) to write separate entries on the twenty-eight stellar lodges, each entry occupying two slips.[75] The position of the handle of the Dipper (*dou* 斗, the Big Dipper), which functions as an astro-calendrical pointer, is the key to the interpretation of the diagram and the stellar lodge entries. Each entry concerns predictions for various activities when the Dipper handle is aligned with the stellar lodge. The system is based on a routine calendrical calculation not on observation of the sky; and s243–244 provide the *qiu dou shu* 求斗朮 "technique for seeking the Dipper."[76]

Considering the space it occupies on the manuscript surface, the astro-calendrical system based on months, stellar lodges, and the Dipper handle constitutes the major content of the Zhoujiatai occult miscellany. A hemerological system that occurs twice in the *rishu* part offers further insight into the production

75 *Guanju Qin Han mu jiandu*, 110–17.

76 *Guanju Qin Han mu jiandu*, 117.

Fig. 3 Zhoujiatai *rishu*, s261–265



of the manuscript. I suspect that the entry on s261–265 was copied in the first stage of manuscript production (Fig. 3). The diagram on s261 shows a column of five rectangles with two lines inside each rectangle and a horizontal line above and below each rectangle. The sum of horizontal lines is thirty (including the top and bottom of each rectangle and the lines inside the rectangles), corresponding to days in the lunar month. Explanation of the system follows in s262–264, with text written down the entire length of the slips rather than in registers. According to the text you count horizontal lines on the s261 diagram always beginning at the top for the first day of any month. When you reach the desired day, the prediction associated with the line in the diagram is the key to the hemerological significance of the corresponding day. The entry concludes on s265 with the statement that the system applies to meeting people and to combat.[77]

The top of s262 is damaged and only the graph *ri* 日 is extant where the name of the hemerological system is written. The name of the related system written in the bottom register of s131–144 is *rong liri* 戎磨日 "*rong* calendar day [divination]" (Fig. 2). The diagram on s131 differs from s261 in two details: each of the

[77] *Guanju Qin Han mu jiandu*, 121 (Harper 2007, 402–3).

five rectangles has three lines inside and there is a horizontal line above each rectangle but not below. The sum of horizontal lines is still thirty, and the procedure of correlating lines with days of the month is the same. More detailed predictions are offered for activities including travel, attacking, capturing people who have escaped, and marriage.[78] Remarkably, the same diagram as s131 is attested in Dunhuang occult manuscripts and is known as the Zhougong *wugu fa* 周公五鼓法 "method of the five drums of the Sire of Zhou." The "method of the five drums" is used to determine the location of lost people and objects based on correlating days of the month with the horizontal lines of the diagram.[79] Except for the diagram there is no evidence of direct correspondences between the two Zhoujiatai *rong liri* hemerological systems and the medieval "method of the five drums."

Although the occurrence of the *rong liri* hemerological system on s131–144 is at the beginning of the manuscript, it seems to have been added in the blank space below the list of months and stellar lodges in the upper part of s131–154 after the entry on s261–265 was copied. I can offer only conjectures about how this occurred.[80] The entire manuscript is written in neat clerical script (*lishu* 隸書) and appears to be the hand of a single copyist (the possibility of another copyist cannot be eliminated). No doubt the copyist focused initially on the circular diagram and related entries to the right and left of the diagram; the copyist continued to write, moving leftward towards the end of the blank manuscript. At some point—I think after the hemerological system on s261–265 was copied—the copyist decided to use the blank space at the beginning of the manuscript. Whether this was during a one-time process of copying the entire manuscript or whether the copyist worked on the manuscript on several occasions cannot be known. When the copyist used the blank space at the beginning of the manuscript, maximizing the use of all available space on the surface of the bound bamboo-slips was still not an urgent matter. Writing is not crowded onto the slips, and when a briefer entry concerning a hemerological system for the day of childbirth was added at the bottom of s145–148 and s151, the copyist skipped over s149–150 even though the text of the childbirth entry is continuous.[81] Considered together as examples of ancient occult miscellanies

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[78] *Guanju Qin Han mu jiandu*, 120 (Harper 2007, 402–3).

[79] (Kalinowski 2003, 243 and 299).

[80] *Guanju Qin Han mu jiandu*, 120–21, places transcription of the s131–144 occurrence together with another passage on s145–151(see n. 81) before s261–265 without explanation. Texts arranged in registers on a manuscript, with one text above and another below, pose a problem for transcription. The utilization of space on the surface of a manuscript does not determine the sequence in which the content was read by a reader looking at the manuscript. My speculation addresses the stage of manuscript production rather than reading. Modern transcription necessitates sequential presentation of content. In my judgment the sequence in the *Guanju Qin Han mu jiandu* transcription is not based on careful consideration of the arrangement of texts on the manuscript.

[81] For a corresponding entry in Shuihudi *Rishu* B, see *Shuihudi Qin mu zhujian*, 236 (s74–76, second register); and (Liu Lexian 1994, 338–39).

belonging to one person (the deceased), the two Zhoujiatai manuscripts provide evidence of different processes of manuscript production in the circulation of written occult knowledge.

Among Dunhuang occult miscellanies P2610 is a rarity for having occult texts on both recto and verso of the paper scroll, written in what appears to be the same hand. The manuscript most likely dates to the ninth or tenth century. I am tempted to think that the copyist was also the compiler, who selected texts of which two have titles attested in medieval bibliographic records.[82] Let me address evidence of the manuscript's production before its content. The beginning of the manuscript is missing: the first sheet of paper in the current scroll is damaged and there was at least one more sheet of paper before it in the original scroll. The ten sheets of paper that form the current scroll vary in dimension. The first four sheets and the sixth sheet measure 72.6–73.6 cm wide. The other sheets average half that width, except the tenth sheet which is only 26.3 cm wide.[83] Part of the tenth sheet is blank at the end of the recto, and the first text of the verso begins on the back side of the tenth sheet.

Looking at the scroll as ten sheets of paper glued together clarifies two peculiarities of P2610. Most obvious is the addition of a sheet of paper to the scroll while the copyist was writing on the recto (Fig. 4).[84] At the left edge of the

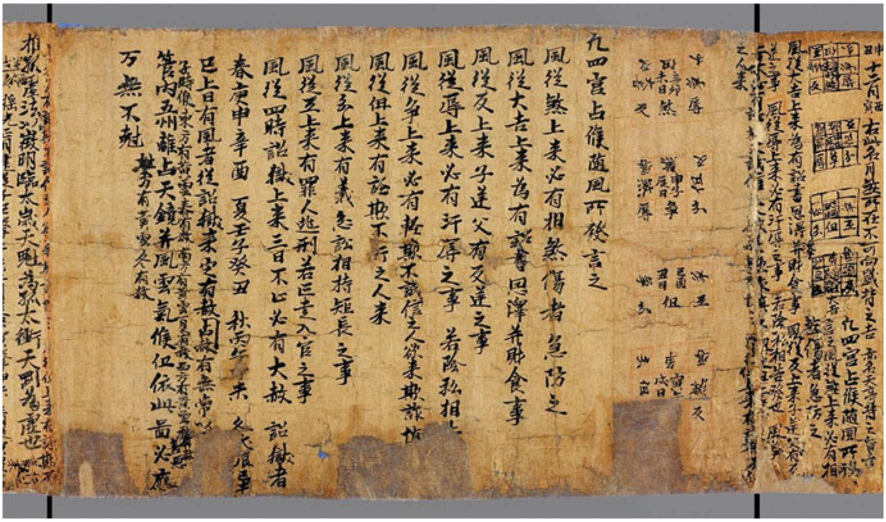


Fig. 4 P2610r°, eighth sheet of paper (heavy *black lines* indicate *right* and *left* edges)

[82] See (Kalinowski 2003, 59–63) for a description of the manuscript.

[83] I have consulted the description of P2610 in the unpublished typescript by Hélène Vetch for the dimensions of the sheets of paper.

[84] The following account is based on my personal examination of P2610 at the Bibliothèque nationale de France in September 2006.

seventh sheet, in a section on wind divination, only the right side of the column of graphs is visible and the missing left side is found at the right edge of the ninth sheet; that is, the column of graphs was originally written over the line where the seventh sheet had been glued to the ninth sheet. The next column on the ninth sheet begins a new section on the *guxu* "orphan-empty" divination system. Looking closely at the ninth sheet, one sees that the copyist had forgotten to finish copying the text of the wind divination section before copying the "orphan-empty" section, and then attempted to correct the error by squeezing the missing text into the margins and between columns of the "orphan-empty" section. Dissatisfied by the result, the copyist took a new sheet of paper—the current eighth sheet—and recopied the entire wind divination section on it. Visible at the right edge of the new, eighth sheet is the left side of a column of graphs that continues the text of the wind divination section where the copyist originally and erroneously stopped, but this effort ends abruptly in the next column over from the right edge after the copyist wrote just three graphs. This marks the point when the copyist decided to use the new sheet to recopy the entire section. When inserting the new, eighth sheet into the scroll, its right edge was glued under the seventh sheet, thus covering the right side of the column of graphs written on the edge.

We can surmise the process followed by the copyist, but not the span of time over which it occurred. The arrangement of the four texts that occupy the verso of P2610 supports the assumption that the scroll's recto was copied first, including the insertion of the eighth sheet. Whereas the sequence of texts on the recto is continuous across the width of the scroll, the space occupied by each text on the verso is defined by the sheets of paper and at least one blank sheet follows each text. Numbering the sheets according to their sequence on the recto, the first text on the verso occupies the tenth and ninth sheets and the eighth sheet is blank; the second text occupies the seventh sheet and the sixth sheet is blank; the third text occupies the fifth sheet and the fourth and third sheets are blank; the fourth text occupies the second and first sheets (and is fragmentary due to damage to the first sheet and to the missing sheet or sheets of paper before the first sheet). The content of the four texts is discussed below; here let me note the distinctiveness of the copyist's use of the verso as if the scroll were composed of separate sheets of paper.

Read from beginning to end, recto first and then verso, P2610 exemplifies the variety of written occult knowledge in a medieval manuscript miscellany and provides evidence of the prospective reader's perception of the manuscript as a source of occult knowledge. The content of P2610r° treats of phenomena in heaven, earth, and the space in between—with topics such as planetary activities, eclipses, rain, and earthquakes as well as astro-calendrical and hemerological systems. The title *Taishi zazhan li yijuan* 太史雜占歷一卷 (Grand scribe-astrologer's miscellaneous divination calendar, in one scroll) is written in c79, meaning that some if not all passages preceding c79 are from this work. The title is not attested in bibliographic records, but recurs in two

Dunhuang manuscripts, P3288r◦ and S2729v◦.[85] Comparison of these manuscripts with P2610r◦ yields a complex pattern of overlapping passages among which it is not certain which are taken from *Taishi zazhan li*, nor is it certain whether *Taishi zazhan li* circulated as an independent work apart from its appearance in occult miscellanies.

All three manuscripts include two passages from *Taishi zazhan li* that address ideas of secrecy and text transmission as understood by medieval readers of occult miscellanies. In P2610r◦, the first passage occurs in c62–65:

> 後有一言 非賢不傳讀者如耳之鳴唯獨知矣所以然者為道重人輕秘而勿傳
> Here is a final word – if the person is not worthy do not transmit. Let the reader be as if the sound in the ear is known only to oneself. This is so because the Way is weighty and humans are light. Keep secret and do not transmit.

The "sound in the ear" is the sound of reading aloud, which the reader should do in a low voice that cannot be overheard. "Keep secret and do not transmit" (秘而勿傳) is typical of injunctions occurring elsewhere in P2610 and Dunhuang occult miscellanies. As noted above, such injunctions reflect a convention of secrecy in occult literature at a time when the nature of manuscript production already ensured that the literature was well known. The second passage (P2610r◦, c76–78) relates how the ancient culture hero Wu Zixu 伍子胥 (fl. fifth century B.C.)—who in medieval times was famous for his occult expertise—acquired occult books from a white-haired old man. The account repeats the theme of secrecy.

Turning to the verso, the first of the four texts on P2610v◦ (c1–64, on the tenth and ninth sheets) is an excerpt of the *Nici zhan* 逆刺占 (Divination by anticipation). The book title is attested in medieval bibliographic records. The title is not written on P2610v◦, but the text corresponds to the final sections of P2859B, one of two Dunhuang manuscript copies of *Nici zhan*, which includes the title as well as the copyist's name (Lü Bianjun 呂弁均, student of *yinyang* studies at the prefectural school in Dunhuang) and is dated 904.[86] The second text (c65–101, on the seventh sheet) is hemerological. The third text (c102–115, on the fifth sheet) contains thirteen recipes for love charms under the heading "Rang nüzi furen shu bifa" 攘女子婦人述秘法 (Record of secret methods to seize girls and women).[87] The fourth text (c116–204, on the second and first sheets) is identified in c116 as *Dijing zhong* 地鏡中 (Earth mirror, middle part). A table of contents follows the title in c117–119. The first five section headings are: "Tianzai zhan diyi" 天災占第一 (Divination of heaven calamities, number 1), "Dizai dier" 地災第二 (Earth calamities, number 2), "Yunlei fenghuo zhan disan"雲 雷風火占第三 (Divination of cloud, thunder, wind, and fire, number 3), "Shan zhan disi" 山占第四 (Divination of mountains, number 4), "Shui zhan diwu" 水占第五 (Divination of water, number 5). In all, eleven section headings

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[85] S2729v◦, c94 (Kalinowski 2003, 73–76); P3288r◦, c160 (Kalinowski 2003, 66–69).

[86] (Kalinowski 2003, 447–49).

[87] See (Liu Lexian 2005) for a study of the love charm text.

are legible in the table of contents. Additional section headings in the table of contents are illegible and the main text is missing after the fifth section.

A *Dijing* as quoted in *Kaiyuan zhanjing* has been cited above for a textual parallel with the Wangjiatai occult miscellany. *Dijing* quotations occur in fourteen chapters of *Kaiyuan zhanjing*, which is the source of all transmitted fragments of the work.[88] The *Sui shu* bibliographic treatise lists several *jing* "mirror" works of which only a *Tianjing* 天鏡 (Heaven mirror) in two scrolls was extant in the Sui dynasty (581–618). Among lost Liang dynasty (502–557) works listed in the treatise were a *Dijing*, a *Tianjing*, and a *Riyue jing* 日月鏡 (Sun and moon mirror), each in one scroll.[89] P2610v° is our only evidence of a *Dijing* as it occurred in medieval manuscript copies.

Parallels between P2610v° and*Dijing* quotations in *Kaiyuan zhanjing* prove the textual connection between the Dunhuang manuscript and the work known to the *Kaiyuan zhanjing* compilers. However, there are as many parallels between P2610v° and *Kaiyuan zhanjing* quotations of a *Tianjing*. I suspect that both titles were given to similar collections of occult knowledge; they constituted a type of "mirror" book that revealed secrets of heaven and earth. Xiao Yi 蕭繹, who reigned as Thearch Yuan of the Liang 梁元帝 (r. 552–555), offered clues to the medieval idea of "terrestrial mirror" books in the section on occult matters in his *Jinlou zi* 金樓子 (Golden tower master)[90]:

> *Dijing jing* 地鏡經 (Earth mirror classic) originates from altogether three experts. There is Shi Kuang*Dijing* 師曠地鏡, there is Baize (White Marsh)*Dijing* 白澤地鏡, and there is *liujia* (six *jia*)*Dijing* 六甲地鏡.

Xiao Yi's specification of three traditions of "experts" (*jia* 家) was his explanation of "earth mirrors" in circulation in his day. Curiously, there is no bibliographic confirmation of titles associating either Shi Kuang (the ancient music expert) or Baize with "earth mirror" works (six *jia* is a generic term for occult systems, and also is not attested in the title of an "earth mirror" work in bibliographic records). However, Shi Kuang was associated with a lost medieval occult book entitled *Shi Kuang zhan* 師曠占 (Shi Kuang's divination)[91] and Baize was the spirit protector associated with the demonography *Baize tu* (White Marsh's diagrams), as exemplified by P2682r°. Before questioning Xiao Yi's bibliographic accuracy, we should consider how Xiao Yi understood the title *Dijing jing* (Earth mirror classic). Perhaps it was not a book title in the strict sense but rather was a generic label for a type of occult miscellany that included *Baize tu* and *Shi Kuang zhan* along with *Dijing*, *Tianjing*, and other "mirror" books.

Associating Xiao Yi's account of *Dijing jing* with the P2610v° text suggests how medieval readers might have perceived the Dunhuang manuscript copy as

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88 *Kaiyuan zhanjing*, 4, 98–99, 100–101, 112–20.
89 *Sui shu*, 34.1038.
90 *Jinlou zi*, 5.24a.
91 *Sui shu*, 34.1038.

a type of occult literature. Similarly, there is logic to linking *Dijing* and the Dunhuang manuscript copy of *Baize tu* (P2682r°). As evident in the text-only portion at the end of P2682r°, the content of a *Baize tu* was not exclusively demonic; the mixture of occult knowledge in P2682r° includes passages found in other Dunhuang occult miscellanies and in transmitted sources. Like *Dijing*, *Baize tu* provided medieval readers with a textual mirror to illuminate unusual phenomena along with practical information to guide human response. Seen and read as texts copied onto Dunhuang manuscripts, the form and function of *Dijing* and *Baize tu* as occult texts are evident in ways that cannot be appreciated from quotations of fragments in *Kaiyuan zhanjing* or other transmitted sources.

Occult Knowledge and Three Medieval Works

Two essential characteristics of the continuum of knowledge that I have described as occult but that for the moment it is convenient to identify again as *shushu* "calculations and arts" were: its transmission from ancient to medieval times as a body of written knowledge in manuscripts; and the simultaneous existence of miscellanies alongside formally composed works authored by or attributed to specialists. There are clear differences between ancient and medieval miscellanies discussed above and the medieval works *Wuxing dayi* (Summation of the five agents; compiled by Xiao Ji), *Yisi zhan* (Yisi-year divination; compiled by Li Chunfeng), and *Kaiyuan zhanjing* (Divination classic of [the reign] Opened Epoch; compiled by Qutan Xida and others). The miscellanies reflect everyday habits of manuscript culture in a popular, literate milieu whereas the three transmitted works testify to the stature of the compilers and to their production of masterworks. Compared to the systematically arranged content of the three transmitted works, which bespeaks the intention of the compilers to classify the knowledge in the form of a book, the miscellanies focus on practical aspects of the knowledge rather than on its classification. Yet, the texts themselves arose from a common source: the knowledge set out in writing for readers of miscellanies was the same kind of knowledge associated with ideas about *yinyang* and *wuxing* "five agents" in books whose titles were listed in bibliographic records, some of which survive as fragments quoted in *Wuxing dayi*, *Yisi zhan*, and *Kaiyuan zhanjing*.

How men such as Xiao Ji, Li Chunfeng, and Qutan Xida regarded the common textual base and how they perceived their place in the formulation of ideas and practices associated with *shushu* has significance for modern studies of ancient and medieval Chinese science. Did they use *yinyang* and five agents ideas as the basis for a theory of nature that marginalized religious and divinatory elements? Given that *shushu* and related terms remained broadly inclusive in medieval usage, how did they demarcate what they accepted and how did they

justify its priority? How may we judge their involvement with occult ideas and practices in relation to other intellectual and socio-political commitments?

Wuxing Dayi (Summation of the Five Agents)

Let us consider each man in turn, beginning with Xiao Ji (d. 614) and *Wuxing dayi*, which he probably compiled in the first decade of the seventh century.[92] A descendant of the ruling Xiao clan of the Liang dynasty (502–557), Xiao Ji's biography in the *Sui shu* 隋書 (Book of Sui) notes his expertise in *yinyang suan shu* 陰陽算術 "arts of *yinyang* and numerical calculation." With the founding of the Sui dynasty by Thearch Wen 文帝 (r. 581–604), Xiao Ji was given responsibility for collating *yinyang* books (*yinyang shu* 陰陽書)—*yinyang* broadly denoting divination—in the new ruler's grand bibliographic project. The biography attributes six works to him, ranging from topomancy for domiciles and tomb-sites to physiognomy and chiromancy, but does not mention *Wuxing dayi* (nor does the title appear in the *Sui shu* bibliographic treatise).[93] Tang dynasty attestation of *Wuxing dayi* confirms Xiao Ji's authorship, but after the Song dynasty there is no record of the work in China. However, *Wuxing dayi* was already in Japan by the eighth century and continued to be transmitted there (a Japanese printed edition served as the basis for its reintroduction to China in a Chinese printed edition of 1804).[94]

Xiao Ji's preface to *Wuxing dayi* details his textual project, which was to restore the classical doctrine of the five agents to its rightful place in human affairs[95]:

> Every time that I have pored over the records of the ancients and examined the standard classics, from the time of Fuxi and Shennong down to the Zhou and Han no one did not take the five agents to be the root of government and take milfoil and turtle divination as the precedent for judgment of good and bad.

According to Xiao Ji, the classical model did not survive the centuries of social and political turmoil following the fall of the Han dynasty, and he decries the low state of knowledge in his day:

> Although the arts of divination and augury are still practiced, all derive from teachings of the sinister way (*zuodao* 左道); the methods of turtle and milfoil divination continue to exist, but no one discerns the intrinsic pattern of the hexagram lines and images.

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[92] For biographical information and the textual history of *Wuxing dayi*, see (Kalinowski 1991, 11–32).

[93] (Kalinowski 1991, 12–16).

[94] (Kalinowski 1991, 19–24).

[95] I use the critical edition of *Wuxing dayi* by (Nakamura 1998, 2–3). In my translation I have made extensive use of the French translation in (Kalinowski 1991, 140–41).

He further warns of the consequences:

> Not adhering to the monthly commandments, the seasonal regulations invariably go awry. Missing by a hairsbreadth invariably leads to a thousand-league error. Flood and drought arise and no one knows their source; events of good or ill omen occur and no one knows their significance. Men who do not trust in forms and images, who are reluctant to investigate signs, and who when they observe instances of trickery and delusion deplore those who study them—they are all fixated on the trivial while forgetting the fundamental, and they take issue with the crude while omitting the subtle.

Finally he explains the principle informing the organization of his work:

> I have gathered broadly from the classics (*jing*) and weft-texts (*wei*) and exhaustively searched writings on slips and tablets. The summation is succinctly expressed in altogether twenty-four sections, which are divided and arranged in forty chapters. Twenty-four represents vapor in the calculation of seasonal nodes; the sum of forty is the complete calculation of the five agents. Beginning with explanation of the name and concluding with bugs and birds, everything related to the five agents is all contained in this summation.

Xiao Ji notes two tendencies in contemporary society, both misguided in their treatment of five agent ideas (broadly conceived to include divination and other forms of detecting signs in nature). First there are people who practice crude forms of divination— "teachings of the sinister way"—that deviate from the classical model. Let us assume for the sake of argument that Xiao Ji's scorn is aimed at readers of occult miscellanies who are concerned about mundane matters more than about realizing perfect government in an ordered world. Equally reprehensible are doubters—men "who are reluctant to investigate signs" and who use cases of fraud as a pretext to deny the validity of five agent ideas and to "deplore those who study them" (presumably including Xiao Ji). Five agent doctrine, Xiao Ji argues, has a core of truth that is "fundamental" and "subtle," and that can still be known from classics, weft-texts, and other writings. In editing the textual material he arranged it in the form of a microcosm: the twenty-four main sections of the book are its "seasonal nodes" (the twenty-four divisions of the solar year); the forty chapters into which the twenty-four sections are fitted are its totality, as represented by the sum of the numbers of the five agents (6, 7, 8, 9, 10).[96] The book is the textual realization of an ordered world.

As a classified summation of "everything related to the five agents," *Wuxing dayi* asserts the priority of a renewed five agent doctrine whose main object is government. Missing in *Wuxing dayi* are details of practical applications of ideas and systems, either in the social and political sphere, or in astrology, medicine, and divination.[97] Xiao Ji wrote about these details elsewhere in lost books on topomancy, physiognomy, and chiromancy. As a well-known diviner

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[96] (Kalinowski 1991, 450, n.18).
[97] (Kalinowski 1991, 42–43).

(his biography recounts several occasions when he demonstrated his skill), Xiao Ji wrote as a specialist and presumably expected his books to attract readers in part because of his reputation. The image in the *Wuxing dayi* preface of a man focused more on ideas than on practices needs to be adjusted for Xiao Ji the diviner and author of books that "doubters" might have dismissed.

The apology for five agent ideas and practices in *Wuxing dayi* was, in fact, already articulated in the second century B.C. by Sima Tan 司馬談, grand scribe-astrologer (*taishi* 太史) at the Han court, who formulated the issue as follows[98]:

> In my personal observation the arts of *yinyang* are elaborate with prohibitions and avoidances; they cripple people and make them fear many things. However, for arranging in orderly sequence the great succession of the four seasons they are indispensable.

As an official and astrologer, Sima Tan approved of *yinyang* ideas and practices in connection with ordering the world and government, but regarded their popular dissemination and application to everyday life as a problem for maintaining order in society.

Tension between what some regarded as acceptable, government-friendly uses of five agent, *yinyang*, or *shushu* knowledge and the broad popularity of the self-same occult knowledge continued down the centuries. Moreover, ancient and medieval critics linked abuses of the knowledge to the abundance of occult manuscripts: too many written texts were too easily available. When Wang Chong 王充 (A.D. 27-ca. 100) attacked ideas that he regarded as popular *shushu* superstition, he often quoted passages from written texts which he then refuted, such as *Zangli* 葬歷 (Burial calendar) and *Mushu* 沐書 (Hairwashing book).[99] The problem of abundant written texts is also suggested in the alteration of Sima Tan's statement on *yinyang* arts when quoted by Fan Ye 范曄 (398–445) in the preface to the collected biographies of occult or *fangshu* 方術 "recipes and arts" specialists in the *Hou Han shu* 後漢書 (Book of Later Han). The original statement refers to the "arts of *yinyang*" that cripple people, which in the *Hou Han shu* becomes the "books of *yinyang*" (*yinyang zhi shu* 陰陽之書).[100]

A different attitude toward popular *shushu* knowledge is evident in the following account of Wang Jing 王景 (first century A.D.), recorded in the collected biographies of *xunli* 循吏 "astute officials" in the *Hou Han shu*[101]:

> (Wang) Jing thought that what was recorded in the Six Classics all partakes of divination; execution of affairs, activity, and repose are rooted in milfoil and turtle. Yet the mass of books was disordered and jumbled; auspicious and inauspicious were mutually reversed. Then he compared and collated the calculation-and-art books of the mass of experts (*zhongjia shushu wenshu* 眾家數術文書) – works on tomb and domicile prohibitions, canopy-and-chassis, day-minister, and the like that were

[98] *Shiji*, 130.3289.

[99] *Lunheng*, 989 and 993, respectively.

[100] *Hou Han shu*, 82A.2705.

[101] *Hou Han shu*, 76.2466.

> suited for actual use – and compiled them in the *Dayan xuanji* 大衍玄基 (Mysterious foundation of the great proliferation).[102]

The *Hou Han shu* also recounts that the young Wang Jing studied the *Yi* (Changes), read broadly in all literature, and was fond of "heaven patterns and arts and calculations."[103] As a government official in several regions Wang Jing had a reputation for reform and innovation (including hydraulic projects for flood control on the Yellow River), hence his inclusion among "astute officials."[104] We do not know when or where he collected *shushu* books and collated them to compile his own *Dayan xuanji*, which disappeared without leaving a trace in bibliographic records. Wang Jing clearly valued *shushu* knowledge. Given the confused state of local *shushu* texts and the importance of the knowledge in the daily conduct of life, his project became to produce a corrected edition "suited for actual use" by people. The description of manuscript production offers one scenario of the compilation of ancient and medieval manuscript miscellanies for local use (by readers and the non-readers who relied on them).

Closer to Xiao Ji's lifetime, Yan Zhitui 顏之推 (531–591) condemned "*yinyang* teachings" and "perverse and unorthodox books" (*pianpang zhi shu* 偏傍之書) that spread false knowledge.[105] A second passage in his *Yanshi jiaxun* 顏氏家訓 (Mr. Yan's family instructions) is a qualified defense of the "arts of *yinyang"* which nonetheless attacks books that he once studied (five are identified by title) and concludes[106]:

> Books of arts transmitted in the world all issue from the stream of folkways (*liusu* 流俗). Words and phrases are base and shallow; verification is rare while fraudulence is frequent.

The judgments and invective of Yan Zhitui, Xiao Ji, and others appear stereotyped in their representation of correct use and abuse of *shushu* knowledge. Correct use was defined by the activities of the few who perceived its subtlety and for whom the knowledge was grounded in classics (which might or might not extend to weft-texts) and a limited number of genuine texts; popular use was abuse, which the circulation of fraudulent texts worsened. However, Yan Zhitui admitted studying *yinyang* books that he later repudiated—he once participated in the popular abuse that he disavowed. The admission is instructive for our study of manuscript miscellanies as one part of ancient and medieval *shushu* or occult literature. Yan Zhitui was thoroughly familiar with the popular texts that he dismissed and he knew the role they played in people's lives. Manuscript miscellanies offer us direct attestation of the texts.

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102 *Dayan* 大衍"great proliferation" refers to the numerology of counting milfoil stalks for divination as recorded in *Zhouyi*, 7.20a–23a ("Xici" 繫辭).

103 *Hou Han shu*, 76.2464.

104 For Wang Jing's hydraulic expertise, see (Needham 1971, 281 and 346–47).

105 *Yanshi jiaxun* (1980, 2.102–4).

106 *Yanshi jiaxun*, 7.520–21.

Yisi zhan (Yisi-Year Divination) and Kaiyuan zhanjing (Divination Classic of [the reign] Opened Epoch)

There are broad similarities between the lives of Li Chunfeng and Qutan Xida and between their books. Both men had successful careers at the Tang court and held positions in the bureau of the grand scribe-astrologer. Li Chunfeng composed treatises on heaven patterns, calendrics, and the five agents for histories commissioned by Taizong 太宗 (r. 627–649).[107] *Yisi zhan* was most likely completed in 645, which corresponds to a *yisi* 乙巳 year in the sexagenary cycle.[108] The book is listed in Tang and Song bibliographic records, but *Yisi zhan* disappeared after the Song until suddenly reappearing in the seventeenth century. Modern editions are based on Lu Xinyuan's 陸心源 1877 woodblock printing of a manuscript in his possession.[109] Compilation of *Kaiyuan zhanjing* was ordered by Xuanzong 玄宗 (r. 713–755), with Qutan Xida at the head of experts from the bureau of the grand scribe-astrologer. Work on the book may have begun as early as 714 and was completed before 724; the title derives from Xuanzong's reign era Kaiyuan (Opened epoch; 713–741). Like *Yisi zhan*, *Kaiyuan zhanjing* is listed in Tang and Song bibliographic records, and disappeared after the Song until 1616 when Cheng Mingshan 程明善 discovered a manuscript copy in the abdomen of a statue of the Buddha that he was restoring.[110]

Whereas *Wuxing dayi* is organized mainly by *yinyang* and five agent systems— with emphasis on correlations with stems, branches, and the sexagenary cycle and on their application to heaven, earth, and humankind—*Yisi zhan* and *Kaiyuan zhanjing* treat categories of phenomena, beginning with heaven, sun and moon, planets, constellations, and unusual celestial phenomena including comets, wind, and rain. There are accounts of cosmology and the structure of heaven that quote otherwise lost ancient and medieval texts; texts adduced under specific phenomena focus on the significance for divination. *Kaiyuan zhanjing* is the larger book—120 chapters in the transmitted text—and quotes more sources by title on a broader range of topics (for example, demonology, weird domestic phenomena, and divination systems for wild and domestic animals). *Kaiyuan zhanjing* is the most important source of textual fragments from lost *shushu* books, and quotations of lost *chenwei* "prophecy and weft-texts" attest to the amount of occult knowledge that was transmitted in them.[111]

Yisi zhan is more compact—100 sections in ten chapters in the transmitted text—and more focused on astrology and associated forms of divination. Li

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107 See (Chen Meidong 2003, 350–52) for a summary of main events in Li Chunfeng's life based on the *Jiu Tang shu* and *Xin Tang shu*.

108 (Chen Meidong 2003, 351).

109 *Jiu Tang shu*, 47.2037; *Xin Tang shu*, 59.1544. See Lu's preface to *Yisi zhan*, 1a, for seventeenth century bibliographic notices.

110 *Xin Tang shu*, 59.1545; *Song shi*, 206.5234. For details of the Ming rediscovery, see (Chen Meidong 2003, 361).

111 see above, pp. 50–51.

Chunfeng's views on *shushu* specialists and their writings are presented in the preface and again at the beginning of section 3. The preface also explains his idea for *Yisi zhan*[112]:

> I have not considered trivial learning when collecting their records. (The passages) are gathered by category and arranged in sequence to form a book. I have selected the choicest blooms and eliminated what is superfluous and false. I have done no more than to find the mean between small and large, beginning with heavenly images and concluding with wind and vapor. There are ten chapters altogether, on which the title *Yisi* has been conferred.

The classification scheme of the book by chapter is: chapter 1, heaven and sun (sections 1–6); chapter 2, moon (sections 7–14); chapter 3, principles of astrology (sections 15–21); chapter 4, five planets (sections 22–27); chapter 5, Mars and Saturn (sections 28–33); chapter 6, Venus and Mercury (sections 34–39); chapter 7, "flowing stars" and "guest stars" (sections 40–46); chapter 8, comets and meteoromancy (sections 47–52); chapter 9, meteoromancy (sections 53–67); chapter 10, wind divination (sections 68–100).

Li Chunfeng's statement in section 3, "Tianzhan" 天占 (Heaven divination), provides more information about his use of text sources in compiling *Yisi zhan*[113]:

> After *Yellow Thearch Divination* (*Huangdi zhan* 黃帝占) and moving down to the several tens of experts, some among them are genuine and some false. They cannot all be followed. In composing the sections I have judiciously selected those whose reasoning is proper and have eliminated the others or placed them in a lower position. Also included are passages from classics and their ancilla as well as from texts of the masters and histories. So long as they are relevant and evince acceptable reasoning, I do not reject them. Let me record now the list of old divination books so as to acknowledge the men (who produced them). After I commence the divination sections I no longer fully cite their names. I would not dare to conceal them. My reason is simply that these are (works) I recited by rote in my youth; which came first and which after is jumbled so that I fear mistaking the correct original.

Titles of twenty-seven books follow, including eight *wei* "weft-texts." These books were hardly the whole of available *shushu* literature with astrological content, but they were significant to Li Chunfeng because as a youth he "recited them by rote." Li Chunfeng would have the reader believe that when compiling *Yisi zhan* he relied on his memory of their content, and that fear of misattribution (because the books and content were jumbled in his mind) made him refrain from identifying the sources that he quoted. I doubt that Li Chunfeng compiled his book from memory without reference to written texts. He chose to omit regular citation of text sources by title not, I suspect, because of a faulty memory but rather because of the nature of *shushu* literature. As we have seen with manuscript miscellanies, overlapping content was common across the many manuscripts in circulation. When several books record the same words

112 *Yisi zhan* , Li preface, 4a.
113 *Yisi zhan*, 1.10b–11a.

concerning a phenomenon such as an eclipse of the sun, who is to say which is the "correct original" text? In compiling *Yisi zhan* Li Chunfeng probably collated sources containing identical passages, and the wording recorded in *Yisi zhan* represents an editorial decision without passing judgment on "which came first and which after."

Dunhuang manuscripts corroborate the authenticity of parts of the transmitted text of *Yisi zhan* and demonstrate that writings attributed to Li Chunfeng were readily available in Dunhuang in the ninth and tenth centuries. P2632r° is a fragmentary scroll (the beginning is missing), but the colophon at the end of the occult miscellany records the title *Shou jue yijuan* 手決一卷 (Handbook in one scroll) and gives a copy date corresponding to 872 (c216–217).[114] From c107–215 there are numerous text parallels with the transmitted *Yisi zhan*—some but not all attributed to Li Chunfeng—in sections on sun and moon divination and wind divination. *Yisi zhan* is not named in the manuscript, but the compiler or copyist appears to have relied on *Yisi zhan* for the passages quoted.[115]

P2536v° and S2669v° contain text corresponding to whole *Yisi zhan* sections.[116] P2536v° is a fragment with twenty-eight columns of text from the end of the original scroll; a copy date corresponding to 924 is recorded at the bottom of c28. There is no title. While the content of the sections in the manuscript correspond to *Yisi zhan* sections, the section numbering is different. We cannot be certain that the content of the original manuscript was a copy of *Yisi zhan*. Perhaps the section numbering in the manuscript was devised by the compiler or copyist and applied to passages from *Yisi zhan* as well as from other texts that might have been included. Another possibility, given the *Yisi zhan*'s uncertain transmission prior to its reappearance in the seventeenth century, is that the arrangement and numbering of sections in the transmitted *Yisi zhan* are different from *Yisi zhan* manuscripts in circulation during the Tang. A third arrangement and numbering of sections is used in the seventeen columns of text in the S2669v° fragment.

Two more manuscripts attest to Li Chunfeng's presence in *shushu* literature available in Dunhuang. S3326 includes one text on cloud divination with drawings of clouds and explanations; one of the explanations is introduced

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[114] See (Kalinowski 2003, 63–65) for a description of the manuscript.

[115] P2632r° passages that cite Li Chunfeng, with *Yisi zhan* parallel in parentheses are: c112 (*Yisi zhan*, section 5, 1.24b); c113 (*Yisi zhan*, section 5, 1.24b); c153 (*Yisi zhan*, section 100, 10.56a); c159 (*Yisi zhan*, section 68, 10.3b); c162 (*Yisi zhan*, section 69, 10.6a); c188 (*Yisi zhan*, section 82, 10.32a); c193 (*Yisi zhan*, section 84, 10.37a–b). I have not located the *Yisi zhan* passage corresponding to c189. P2632r° text parallels that do not cite Li Chunfeng are: c143–153 (*Yisi zhan*, section 78, 10.18a–19a); c166 (*Yisi zhan*, section 69, 10.6b); c166 (*Yisi zhan*, section 69, 10.6b); c168 (*Yisi zhan*, section 84, 10.38a); c169 (*Yisi zhan*, section 69, 10.4b–5a); c175 (*Yisi zhan*, section 69, 10.5a); c193 (*Yisi zhan*, section 84, 10.37a–b). (Huang Zhengjian 2001, 47 and 50) notes the probable relationship between the manuscript and *Yisi zhan*.

[116] See (Kalinowski 2003, 58–59 and 72–73) for descriptions of the manuscripts.

with “servant Chunfeng states” (*chen* Chunfeng *yue* 臣淳風曰), and Li Chunfeng is the probable referent.[117] P3865, on domicile topomancy, lists books consulted by the compiler, including *Li Chunfeng zhaijing* 李淳風宅經 (Li Chunfeng’s domicile classic).[118] Dunhuang manuscripts indicate that Li Chunfeng and his writings achieved celebrity status in the popular mind following his lifetime. The manuscripts are also prima facie evidence that the Tang court’s wish to prevent the circulation of *shushu* literature (prohibitions are documented in historical sources) was ineffective—even writings by contemporary *shushu* experts in the Tang court circulated among a general readership.[119]

Conclusion

Written texts are the basis of history; our knowledge of ancient and medieval China is in direct correspondence with textual evidence. My idea in this chapter, however, is not to write history with texts but rather to realize the function of manuscripts and texts in the lives of their compilers, copyists, and readers. Ancient and medieval occult miscellanies are ideal textual artifacts for analysis because a manuscript miscellany existed to fulfill readers’ real and perceived needs in daily life (borrowing Wang Jing’s words it was “suited for actual use”). Incentive to produce manuscripts and reader demand were twin forces that shaped *shushu* or occult knowledge and situated it within manuscript culture. Circulation of texts and knowledge occurred by means of occult miscellanies that went unnoticed at the level of bibliographic records with their classification schemes, but that were remarkably effective in perpetuating ideas and practices across centuries—as demonstrated by manuscripts available to us since the twentieth century.

Inclusion of the manuscripts among the sources for the history of Chinese science allows us to situate the transmitted sources within ancient and medieval manuscript culture, to see the relationship of popular occult miscellanies to the works of a few prominent men, and to reconsider how ancient and medieval perceptions of *shushu* knowledge correlate with the categories science or natural philosophy in modern studies. At the level of individual passages, Dunhuang occult miscellanies read like parts of *Wuxing dayi*, *Yisi zhan*, or *Kaiyuan zhanjing*, and at times are verifiably the same text. Xiao Ji and Li Chunfeng criticized the mingling of false knowledge with genuine knowledge in *shushu* literature, and they saw themselves as custodians of genuine knowledge when compiling their own works. As phrased by Li Chunfeng: “I have judiciously selected those

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117 (Kalinowski 2003, 76) proposes that Li Chunfeng was the compiler. (Huang Zhengjian 2001, 51) argues that the text was compiled after Li Chunfeng’s lifetime, and that reference to “servant Chunfeng” indicates that Li Chunfeng was one among several divination specialists quoted in the manuscript.

118 (Kalinowski 2003, 595–96).

119 See (Kalinowski 2003, 44 and 50–55) for discussion of this issue.

whose reasoning is proper and have eliminated the others or placed them in a lower position. . . .So long as they are relevant and evince acceptable reasoning, I do not reject them."

Based on their writings, neither Xiao Ji nor Li Chunfeng defined a separate field of knowledge to distinguish between science or natural philosophy and ideas associated with *shushu*, which embraced magic, religion, divination, and politics. Marc Kalinowski's comparison of five agent doctrine to hermetic traditions in the Mediterranean world is apt[120]:

> S'il fallait trouver un équivalent à la doctrine des cinq agents dans le monde méditerranéen, il faudrait plutôt chercher du côté des traditions hermétiques grecques et latines, principalement dans l'astrologie dont l'importance au sein de ces traditions n'a cessé de croître durant la période hellénistique et sous l'empire. A l'instar du système astrologique en Occident, la doctrine des cinq agents a mûri au contact des conceptions religieuses, philosophiques et scientifiques de la fin des Royaumes Combattants et des Han antérieurs. Débordant le contexte des pratiques divinatoires, elle a très vite atteint un degré de généralité suffisant pour servir de cadre conceptuel à toute activité. La réduire à un système de philosophie naturelle ne rend pas compte de l'extrême diversité des éléments qui la composent et de ses multiples applications dans le domaine de l'investigation des choses en général, mais aussi dans celui de la politique, de la religion et des arts.

The amount of *shushu* literature as well as its popularity and wide circulation are points of difference with hermetic traditions. Like hermetic traditions, *shushu* knowledge constituted a body of ideas and practices that encompassed natural philosophy and occult thought while simultaneously informing people's experience of life. As Kalinowski states, the knowledge attained "un degré de généralité suffisant pour servir de cadre conceptuel à toute activité." Xiao Ji, Li Chunfeng, and Qutan Xida participated in the world of ideas associated with *shushu* and in the manuscript culture that fostered it. While one might argue that their careers and writings warrant special consideration in modern studies of ancient and medieval Chinese science, their accomplishments are best appreciated with all evidence brought forward, including occult miscellanies.[121]

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[120] (Kalinowski 1991, 47).

[121] I do not concur with Needham's repeated characterization of Li Chunfeng as a foremost medieval mathematician, for example (Needham 1959, 38); nor with Nakayama's judgment that the *Wuxing dayi* "represents the highest achievement of Chinese natural philosophy" (Nakayama 1969, 59).

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Sanskrit Scientific Libraries and Their Uses: Examples and Problems of the Early Modern Period

Christopher Minkowski

Introduction

Sanskrit philologists are not usually thought of these days as intrepid, but in their search for manuscript collections more than a century ago they were required to brave arsenic, plague, and worst of all, corrosive, insuperable suspicion. The essay that follows is about how that came to be so; it is also about science, broadly defined; about texts and their study as an inalienable part of science and its history; and about gaining access to collections as a strenuous sport.

The Problematic

The problematic of the present volume—concerning the "processes of shaping" of pre-modern Asian scientific collections—presents a challenging double agenda. It proposes that the history of scientific collections, and of the selection processes that produced those collections, can illuminate the social history of scientific communities and their practices, on the one hand, and can provide a source for the methodological re-evaluation of the modern study of those past scientific practices, on the other. The broadly comparative nature of the agenda as it has been articulated promises furthermore to open up the history of sciences and knowledge systems to global perspectives, freeing their study from parochial approaches and unwarranted or hidden assumptions. This is a valuable agenda for a number of reasons, but it is not one that is simple to achieve.

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F. Bretelle-Establet (ed.), *Looking at It from Asia: The Processes that Shaped the Sources of History of Science*, Boston Studies in the Philosophy of Science 265,
DOI 10.1007/978-90-481-3676-6_3,

The Application in the Case of India—Three Questions

To consider pre-modern Indian sciences and systems of knowledge from this point of view we would want to pose two research questions: (1) What was the role of collections in pre-modern Indian scientific and intellectual practices? That is, what was their "indigenous" use? (2) In more recent periods, what has been the role of research collections in forming the historical understanding of the practices considered under question (3)?

By "pre-modern Indian sciences and systems of knowledge" are meant here more specifically the Sanskrit *śāstra*s or learned disciplines, the sources for the historical study of which are largely constituted by collections of Sanskrit manuscripts. More will be said about the *śāstra*s and their sources below.

Pursuing these two research questions through the disciplines of the *śāstra*s presents problems, both conceptual and practical. The conceptual problems emerge from the distinction between past and present that is embedded in the research questions formulated as (1) and (2). To be more specific, they emerge from the nature of modernity in India and the history of its arrival. This is a contested historiography, where the prevailing historical narratives do not seem to account well for the current shape of India's experience of the modern world.

The practical problems have to do with the amounts and types of materials available for study. Paradoxically we have at once too much and too little in the way of primary research material—vast numbers of Sanskrit texts in manuscript form, but very little in the way of archival records of the sort necessary to reconstruct an intellectual history of the society of the learned, or a social history of intellectuals.

As a way to answer the two research questions at least provisionally, in what follows I shall consider three collections of Sanskrit manuscripts, all of which date from the "early modern" period of Indian social and cultural history. I shall investigate these questions from an "early modernist" point of view, as a way through the conceptual and practical difficulties alluded to above. By way of background I shall begin with a discussion of three topics: pre-modern Sanskrit sciences and their sources; modern research collections of Sanskrit source materials and their history; and the problem of Indian modernity and early modernity, as it pertains to the consideration of scientific collections in Sanskrit.

Background

Pre-modern Sanskrit Sciences and their Sources

There has been European interest in Indian sciences for more than three centuries. This interest has, for the most part, taken the form of studying the history of the *śāstra*s, the systems of knowledge that were communicated in

Sanskrit among learned communities of Indian specialists. Of all the knowledge traditions that were communicated in the Indic languages, it is the surviving Sanskrit material that is the richest and most extensive; and it is *śāstric* intellectual disciplines that have had the most widely felt impact and afterlife, in India and elsewhere.[1] The disciplines included astronomical and medical sciences, linguistic and grammatical sciences, as well as hermeneutics, logic and natural philosophy, and moral-legal-political discourse, among others.[2]

The contemporary academic discipline that studies the history of the Sanskrit knowledge traditions is called Indology by its practitioners. Indology began to take modern shape in the early nineteenth century, when it took a philological turn, that is, when Indologists decided to ground their truth claims almost entirely on the demonstrable evidence that could be derived from the study of Sanskrit manuscripts. On this view, manuscripts were the material artefacts that provided unmediated access to the intellectual life of Indian learned communities from earlier times.[3] Since that turn was taken, Sanskrit manuscripts have served as the objective basis for the operation of the modern discipline of Indology.

The Sanskrit manuscripts that have served this scholarly purpose have mostly been held in institutional collections, in the libraries of institutions of learning, or of civil and state institutions. While there are important collections of Sanskrit manuscripts in Europe, the Americas, and elsewhere in Asia, with titles numbering in the tens of thousands, most of the Sanskrit manuscripts that are held in institutional collections are held in Indian ones. It is generally supposed by specialists in the field, however, that the vast majority of extant Sanskrit manuscripts are still in private hands in India, outside the control or knowledge of institutions or academic readers.

How the institutional collections that have served Indological purposes were formed, beginning in the late eighteenth century, forms an unavoidable part of the history that I wish to tell of an earlier period, and I will therefore dwell on it here.

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[1] In making this statement I leave aside the output of intellectual communities which were based in South Asia but which communicated their arts and sciences in Arabic and Persian. Those learned communities, it has usually been asserted, participated in a different cosmopolitan universe of discourse, which was spread across Europe, Asia and Africa. The story of their contact with, and mutual appraisal of, the Sanskritic learned disciplines remains largely un-written, but see for the astronomical materials (Pingree 1978), and (Pingree 1996, 474–75). I can do no more here than note the limitation of the claim I have made in the body of the text, which is tantamount to identifying the Indic with Sanskritic. This limitation is the legacy of a really determined academic organizational decisions of the past. It awaits an energetic reconsideration.

[2] See (Pollock 2001). See also the materials developed by the research project he directs, at http://www.columbia.edu/itc/mealac/pollock/sks/

[3] This constitutive Indological decision was a choice. The alternative would have been to continue to ground truth claims in the authority of statements made by the living exponents of the Sanskrit learned disciplines, as earlier European visitors had done. On this point see Dhruv Raina's essay in this volume.

Modern Research Collections and their History—"Report of a Tour"

The formation of modern institutional collections of Sanskrit manuscripts is most clearly and explicitly discussed in a series of reports that were produced by the Sanskrit scholars resident in India who went on tours of the country to search for them. Most of these men held positions in institutions of higher learning founded by the British. The reports of their searches were made to the Director of Public Instruction in the relevant Presidency, forwarded up the line to the Home Department, and subsequently published.[4] The tours and searches were supported by funds from the central British Government in India, which made the decision to commission these searches on 3 November, 1868. The tours, lasting usually for the three months of the winter season in India, began in the 1860s and continued nearly annually for about fifty years. Those charged with the task hired assistants, mostly "natives," to help them; some of the assistants operated largely independently. The collectors who filed the reports for the Bombay Presidency, for example, operated over an expanding area, eventually over what one collector called the "Bombay Circle," that is, the "Bombay Presidency, Rajputana, Central India, and the Central Provinces."[5]

The reports describe Sanskrit manuscripts which the collectors came to know of in their tours, and which they treated in a variety of ways: at the very least, the collectors had the manuscripts shown to them and made note of their titles and other details; at most, they bought the manuscripts outright. In many other cases, they copied out excerpts from the manuscripts, or had manuscripts copied out in their entirety.

These searches were not the first, nor were they the only attempts by British or other Europeans to establish collections of Sanskrit manuscripts. Substantial collections had already been built up in British-administered Bengal from the late eighteenth century. The searches supported by the Government of India beginning in the 1860s were, however, the ones most systematically carried out, and the ones for which we have records that are systematically preserved and published.

The reports make edifying reading even today, both for Indologists and for historians. For the Indologist there are descriptions of manuscripts of otherwise unknown works, which a collector might have seen in a private home, but which have not come to light again elsewhere, or at least not in the same form. For the historian there are remarks about the sorts of collections, and about their size, location, and type of owner, and about the owners' orientation to their collections, measured in degrees of neglect, and what its condition was, therefore. More to the point for the current research problem, there is considerable description of the process of searching and selecting itself.

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[4] Most of the reports are listed in (Janert 1965). See also (Gough 1878).

[5] See (Peterson 1895).

What the Collectors Wanted to Do

The first thing that one learns from reading these reports is that there was a gap, noticeable even to the collectors, between what they wanted to do and what they could do in fact. The consideration of what intervened between the two, that is, of reality, will bring us to the main point of the study that follows.

What the collectors wanted to do was clearly expressed in the very first report, by Georg Bühler, at that time Professor of Oriental Languages in Elphinstone College. Under instruction from the Director of Public Instruction, Bühler undertook a search for Sanskrit manuscripts in the "southern Marātha country" in the winter of 1866–1867.[6] His goals were several: as he put it, in the first instance to "further really the interest of Sanskrit philology" by searching for manuscripts of Sanskrit works that were 'hitherto unobtainable," and whose recovery would "contribute to the solution of some of the many pending questions in Sanskrit philology."[7]

Bühler also wished to acquire important works for the government's libraries in Bombay and Poona (or Puna, in Bühler's spelling,) which might be available elsewhere, that is, in government libraries in the Bengal and Madras Presidencies, but which were "wanting" in the comparable Bombay institutions, or which were available there only in defective or inferior copies. In an era in which most Sanskrit works remained unedited and unpublished, he also sought to provide the research materials necessary for producing textual editions of canonical Sanskrit works for a projected publication series.[8]

In order to accomplish these aims, Bühler had a list of desirable works prepared and circulated in advance to "all Shastris and other persons, who showed themselves ready to assist in the search for manuscripts."[9] In addition he attempted to obtain copies of whatever lists there might be for collections that were "in the possession of Shastris and other native gentlemen in the places visited."[10]

Bühler "invited the Shastris and Sanskrit Scholars of every town visited" to meet him, so that he could explain the objects of his mission, and discuss interesting points of Sanskrit language and letters with them. The reason for this activity was that Bühler hoped "by a personal acquaintance, and by showing a real interest in their ancient language and culture, to remove, or at least to lessen the aversion, which natives generally have, to giving or even showing

[6] (Bühler 1868, 315–25). This tour was commissioned by the Bombay Presidency before the central Government decision to institute the searches. The towns that Bühler mentions are (in his spelling), Puna, Sattara, Kelgaum, Ashte, Kolhapur, Sângli, Nipâni, Sankeshwar, Yamkhandmardi, Belgaum, Dharwar, Nargund, Navalgund, and Hubalî. Note that the "Marâtha country" of the Bombay Presidency extended well into the modern Indian state of Karnataka.

[7] (Bühler 1868, 315).

[8] (Bühler 1868, 316).

[9] ibid.

[10] ibid.

their books to strangers, and particularly to foreigners."[11] This "aversion" is a recurrent theme of the reports, from the beginning of the search period to the end, and we will return to it.

For Bühler, then, the purpose of the searches was to expand the disciplinary knowledge of Sanskrit philology, by looking for what was "old and rare"—old manuscripts, that is, or rare, i.e. previously unobtainable, works. As a secondary matter it was to expand the government's collections, with manuscripts of canonical and classical Sanskrit texts.

There was a corollary ambition, which was simply to *know* about any old or rare treasures in private possession, i.e. in the hands of "native" Sanskrit scholars, even if it was not possible to purchase, copy, or even read them. This ambition was expressed with an increasing sense of urgency in the reports, and eventually they included lists of some private collections, which aimed at completeness.[12]

In general the searches turned up three sorts of collections, the first being the private ones of individual scholars, as has been mentioned above. These often constituted collections that had belonged to a family over several generations. There were also royal collections, that is, collections belonging to a court, or a princely family, or a particular ruler. Then there were the collections belonging to indigenous institutions—schools, temples, and monasteries. Of especial interest to the collectors in the "Bombay circle" were the collections that belonged to Jain temples and monasteries. The searchers hoped that the collections in Pātan in Gujarat might still retain very old and very rare Sanskrit manuscripts. Pātan had been the site of Jain higher institutions of learning since at least the twelfth century, when the town had been Aṇahilapātaka, the capitol of the Caulukya kingdom. The Jain monks espoused a philosophy that required of them a pluralist approach to truth, and that therefore supported an encyclopaedic interest in what was known and thought in the Sanskritic cosmopolitan world. They famously collected very widely. And indeed, some of the manuscripts that the collectors of the nineteenth century saw in Pātan were very old by the standards of Indian manuscripts, some copied between the twelfth and fourteenth centuries. They included copies of works not otherwise extant. For this reason the visits to the institutions in Pātan received considerable attention in the reports.[13]

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[11] ibid.

[12] See (Bhandarkar R. 1882, 3).

[13] The age of the manuscripts mentioned might not seem terribly old, but it must be remembered that the climate and the insect population of India did not and do not conduce to the long term survival of manuscripts that are made of the very biodegradable materials on which manuscripts were copied, i.e. home-made or "country paper," palm leaves, or birch bark. Ideally a manuscript should be recopied after a century of use. The implications of these material facts in the present for the impending loss of a vast cultural heritage, given the cessation of manuscript copying traditions by the end of the nineteenth century, are dire.

What They Could Do In Fact

What happened when the collectors and their teams tried to fulfil their programmatic ambitions? They sometimes found it very difficult going. The collectors appear to have been often thwarted by circumstances, though this was not always acknowledged too explicitly in the reports, which after all were addressed to the officers who had funded them. Nevertheless, if the reports are anything to go by, the contrariness of the world at large was surpassed only by the contrariness of the owners of the manuscripts.

There were the difficulties of travel itself, of which we get a hint when Bühler complains that the General Quarter Master was unwilling to issue him a tent to use for his first tour, which therefore restricted the number of places he could visit.[14] There was as well an ongoing problem with epidemic diseases, especially plague, about which we hear from more than one collector. It was the plague that carried off the owners of a number of private collections, or that drove owners out of the country.[15] Other collections were made inaccessible simply by neglect: locked in a cupboard in an abandoned house, or covered in inches of dust, or blackened by the soot from a perpetual devotional lamp, or sewn up in a jumble in a burlap sack. Only rarely did the collectors find lists or catalogues or other explicit ordering schemes in place, aside from what was kept in the mind of the owner.

What caused much more trouble to the collectors was the widespread unwillingness of owners or curators to show their collections. Bühler's initial concern about their "aversion" was noted above. Rajendralal Mitra, writing in 1875 to the Asiatic Society about a search in the Bengal Presidency, said of the "accessibility" of manuscripts in the private collections of *Śāstrī*s in that region, that

> the worthy professors, deeply learned as they are, are not open to worldly influence, and are extremely shy and suspicious. In their estimation the most valued treasures they possess are their MSS., and they evince the greatest reluctance to shew them to strangers. Ordinarily they do not flatly refuse access to their stores, though some do so; but the passive resistance they offer is often insurmountable. The first day's visit is generally passed in conversation; on the second day a few of the commonest works are shewn; on the third the proprietor is busy with other duties and has no time to bring out MSS.; on the fourth day he is not at home; and so on. Several days are lost before a really good MS. is brought to light; and as my plan requires the copying of the initial and final lines, and an abstract of the contents, a great deal of valuable time is lost before a single collection is finally examined; and before this consummation can take

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[14] (Bühler 1868, 315). This complaint comes as the very third sentence of the report.

[15] Bühler noted, slightly ghoulishly, the advantages that were created by the plague: "Again a great number of Brahminical families have been reduced to extreme distress by the high prices for the necessaries of life which prevailed for more than two years, and by the inability of their Yajamâns, or spiritual clients, to give them the customary support. These special circumstances, regrettable as they are in other respects, have enabled me to collect this year in 9 months more Brahminical manuscripts than I have ever obtained before in Gujarât, and to obtain them at a cheaper rate than usually" (Bühler 1880, 3). The effects of the plague epidemics are noted by R.G. and S.R. Bhandarkar as well.

> place, it often happens that the owner of the MSS. is called away by a distant invitation or some other errand, and my travelling Pandit's work is brought to a stop. No possessor of a Ṭol [a small Sanskrit school] has any catalogue or list of his MSS., and if by dint of repeating the names of a great number of rare works, the owner is made to acknowledge he has a particular work, very little advance is made towards getting access to it, for the bundles in which MSS. are kept are not numbered; and as from six to twenty different works find place in each bundle, the task of finding it out takes days, if it be forthcoming, which is not always the case.[16]

Difficulties of this sort were known to every collector. Indeed Bühler as a result often hired "paid agents [who] had to be selected more according to their fitness for gaining access to the often jealously guarded libraries than according to their learning."[17] And even these "paid agents" were not always successful. In Pātan, Bühler reports, "the Paṇḍit had to sue for many months in vain, as the leading Jainas feared that some sinister attempt against their books might be intended when the new catalogue had been prepared."[18] S.R. Bhandarkar in a report from the "Bombay circle" in 1905 recounted the suspicions that were believed even by some employees of the local English school: "One was that the Government intended at no distant date to confiscate all manuscripts in the possession of the people. . . . Some suspected that Government wanted to make an end of all ancient Indian literature by throwing the manuscripts into the sea."[19]

Some pandits, it must be said, preferred to drown their collections themselves, rather than allow them to be seen or used by others, especially not by strangers. R.T.H. Griffiths reported a story circulating in Banaras, about a Pandit who had "tied up and sealed all his books in bags, making a will that they were to be sunk in the Ganges as soon as his life was extinct; and leaves of books have often been seen floating in the river."[20]

On the Problem of Indian Modernity

Now, what does this history of the difficulties that the collectors faced tell us about scientific collections, and about the processes of selection that shaped them? The most straightforward approach to answering this question would be to seek to explain the collectors' difficulties as the result of the historical conditions under which their searches took place. But here a difficulty arises, due to a problem in the narrative of Indian modernity.

[16] "From Bábu Rájendralála Mitra, to Captain J. Waterhouse, B.S.C., Secretary to the Asiatic Society of Bengal, – No. 47, dated Calcutta, the15th February 1875." Cited in (Gough 1878, 25).

[17] (Bühler 1871, 2–3).

[18] (ibid., 2).

[19] (Bhandarkar S. 1905, 2).

[20] R.T.H. Griffiths, cited in (Gough 1878, 40).

One prevalent model of Indian historiography in recent years has maintained that India's modernity was most saliently a "colonial modernity," which assumes that there was a sharp break between "traditional" and "modern" India; that the transformation from "traditional" to "modern" was sudden, the result of a unilateral foreign imposition; and furthermore, that there was a comparably radical break between "traditional" and "modern" forms of knowledge and epistemic practice; and that this break was attributable to the sudden transformation in the relations of power associated with the assertion of colonial dominance.

There are a number of difficulties with this model in general. Here we will only consider the difficulties that pertain to the history of institutional collections of Sanskrit materials, before turning to the "early modernist" historiography that has been offered as an alternative.

On the "colonially modern" view of history, the British government's search for manuscripts would be seen as an example of the epistemic regime change, which was manifested in the colonial will to gain panoptic knowledge and thereby to dominate. In turn, the unwillingness or aversion of the "Natives" to show their private holdings would be seen as resistance, of a weak and "everyday" sort, but nonetheless explicitly political in the same terms. In this historiographical vision, collecting was the prototypical activity of the colonial officer, who wrenched objects from their traditional, and thus organic, contextually grounded use, and deposited them in the dislocated, commodified setting of antiquarian display in a museum.

This account, however, overly emphasizes discontinuity, a rupture between traditional and modern, and assumes among other things an unprecedented and sudden newness for the economic transformation of the period, putatively reflected in a wholly new consciousness of the value and meaning of manuscripts. In fact, the value of Sanskrit manuscripts as the products of labor and as items for sale had been known and understood—both in economic terms as well as in terms of their "intellectual capital," well before the advent of European collectors. Even a sense of the old and the rare had been present as a criterion for acquiring manuscripts in earlier periods, as we shall see.

Other things complicate the appeal to colonial modernity as fully explanatory of this particular case as well. To begin with, the official in the Home Department who approved the project had to stretch a point to find any utilitarian purpose in it. It is rather obvious in his Minute that he had doubts about the use of funds for "measures which offer no palpable return of present or prospective advantage."[21] Indeed, the impetus for the project came from "Pandit Rádhákṛishna, Chief Pandit of the late Lahore Durbar," that is, from a

[21] "Minute by Major-General the Hon'ble Sir H.M. Durand, C.B. K.C.S.I—dated Simla, the 13th August 1868," cited in "Gough 1878, 7". Durand ends the Minute however by holding out a governmental hope that the project may result in "many now uncontemplated practical uses and modes of effective leverage on the manifold masses and phases of the Hindu mind" (Gough 1878, 8).

traditionally educated figure who was not a servant of the British Government, but had been, rather, the leading intellectual of a princely court that had come within the political ambit of the British only recently.

What is more, the searches were directed by Indians as much as by Europeans, among them R.G. Bhandarkar and Rajendralal Mitra, and the staff for the searches was made up almost entirely of “Pandits and Shastris,” that is, of Indians with traditional educations. The Europeans involved were learned orientalists with many years of in-country experience, often well-educated in Sanskrit in something like the traditional way: Bühler was not the only one who conversed with the “native gentlemen” in Sanskrit. Most of the authors of the reports were aware that the learning of the Sanskrit literati whom they met exceeded their own, and were willing to say so.

Then again, the “native gentlemen” with whom they conversed were not uniformly unwilling to show their collections; and if initially they were, their minds could be changed. The reports all show that the owners of private collections could be, and were sometimes, persuaded. If they were very learned they tended to be all the more likely to understand the purpose of the project. All of this argues against understanding there to have been any radical or unbridgeable discontinuity between traditional and modern worlds.

Early Modern South Asia

It must be acknowledged that in the colonial period an unprecedented shift took place, among other things, to a new way of producing and valuing knowledge, and of investing it with meaning. I would argue, however, that this shift was more a continuation of processes under way than it was a starkly imposed break between two incommensurable epistemic modes of understanding.

To argue in this manner is to adopt what could be termed the “early modernist” account of Indian modernity. The general argument of this early modernist historiography is that many features of the transition to India’s particular form of modernity were already under way before European powers established political domination over any part of the subcontinent. In these terms, the early modern period in India should be understood to have lasted approximately from 1450 until 1750 CE.

To return to the collectors and searchers for Sanskrit manuscripts in the colonial period, there is a further claim to be made, namely that what the collectors encountered and transformed was not simply the unchanging “traditional” state of things in the world of the Pandits and Shastris. What they encountered, rather, was in large part the legacy of the early modern world of Sanskrit learning. It was this legacy that shaped the institutional collections of Sanskrit arts and sciences in their colonial and modern form in the most meaningful of ways.

What was distinctive of the early modern period has been the subject of considerable recent discussion.[22] It is widely argued that the most salient characteristic is the striking increase in circulation—throughout the subcontinent and beyond it, to include states and societies in west and central Asia—of commodities, texts, skilled personnel, technologies and ideas. This was a period of great expansion in the market for, and circulation of, texts, letters, records and documents of many sorts. Techniques for manufacturing paper inexpensively were introduced into South Asia at the start of this period, and this introduction coincided with an unprecedented rise in the use of paper to circulate information, ideas, and literature. In the Sanskrit scientific world the period is distinctive therefore for the vast numbers of inexpensively produced paper manuscripts.

The number of copyists increased in response to this increased demand. The copyists' educational background ranged widely, from that of the most learned of pandits to the minimal training of scribes who were barely literate in Sanskrit. The period is also characterized by an expansion of the Sanskrit readership, who were now drawn from social groups that had not been afforded access in earlier periods. The world of Sanskrit learning thereby included participants from a much wider range of backgrounds and trainings.

It was not just the increase in the numbers of manuscripts, scribes and readers that was distinctive of the period, however. The structure of the Sanskrit "ecumene" or "public sphere" itself took on a distinctive shape during this era.[23] This structure emerged as an interplay of four social settings for Sanskrit: first, the local, regional, and even imperial courts that patronized and supported the activity of Sanskrit intellectuals; second, learned families, especially the families of Brahmins from the Deccan who moved to Benares in this period, and who created networks of expertise and communication across the subcontinent, (rather along the lines of the family concerns of mercantile and trading families in the same period;) third, schools and other institutions of learning, which operated more or less as intellectual versions of the learned families; and fourth, the religious movements (or *sampradāya*s), such as the followers of Madhva or of Caitanya, who maintained Sanskritic learning in the service of their own distinctive religious projects—proselytizing, ideological, and polemical—and who had become particularly powerful and well-organized over long distances in this period. The organizational structure of the *sampradāya*s, as far as Sanskrit learning was concerned, made use of features already embodied in courts, schools, and families.

The interactions between participants in these four social forms took place in public or quasi-public settings: at court in discussions, recitations and other sorts of displays; in debates and live competitions, often but not always

[22] See (Subrahmanyam 1990, 1997, and 2001) (Alam 2003, 2004) (Rao, Shulman, and Subrahmanyam 1992, 2001) (Washbrook 2007).
[23] (Bayly 1996) (Pollock 2001) (O'Hanlon and Minkowski 2008).

sponsored by rulers; but then also through material circulated in written documents such as the collective judgments of panels of learned experts, or polemical pamphlets that carried on arguments between partisans of different religious, scientific, juridical, or literary standpoints. These arguments could take place independent of any courtly or sectarian authority, as was especially the case in Banaras, which operated as a sort of continent-wide free zone. In short, it was the multiply centred, widely networked, and openly competitive structure of the early modern Sanskrit ecumene that generated the dynamism of literary and scientific production in Sanskrit during this period, a dynamism that was itself another distinctive feature of early modern Indian intellectual history.[24]

What the Collectors Found

It is the discovery of the legacy of this early modern state of affairs that is played out in the reports of the collectors who toured parts of the country in the later half of the nineteenth century. The types of collections they encountered—those of individuals, institutions, and royal families—represented the collections that had been built in this period, or represented the type of collection it had become customary to build in this period.

While the collectors did find some palm leaf manuscripts, and some birch bark ones, (especially in the south of India for the former and the far north for the latter,) what they found the most of were manuscripts made of "country paper."[25] These had been copied no more than four centuries earlier, the majority more recently than that. The collectors mention in passing that, along with the occasional rare and old manuscript, most of the private collections they saw contained the same texts, over and over. Although they did not usually bother to list all of these, given their purpose, their comments remind us nevertheless of an established community of readers and copyists, in contact over long distances; circulating, reading and using many of the same texts, a significant number of which, incidentally, were compositions by authors of the early modern period.

The testimony of the collectors to the uneven condition of the collections makes it clear that in the late nineteenth century private Sanskrit collections were in a state of flux. The condition of the manuscripts, the extent of the collections, their owners' knowledge of them or their continued participation in the Sanskrit ecumene, were all tremendously varied, and were evidently tied to the rising and falling fortunes of families and courts.

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[24] See the essays of participants listed in the bibliography of the research project on the Sanskrit Knowledge Systems available at the website listed under note 2.

[25] This paper was smeared with an arsenic-laden preparation in order to discourage the depredations of insects.

Although many patronage structures had changed in the nineteenth century, this rising and falling need not necessarily be taken as a sign of the dislocation created by the colonial transformation however. Another feature of the early modern period in South Asia was its social mobility, in geographical as well as in other senses, and there continued to be winners and losers in the nineteenth century. Some of the most well known royal collections of western India, on which the reports lavish considerable detail, were created by rulers who came to power only in the early nineteenth century, and who made a re-institution of Sanskrit learning part of their royal program. Thus the collection of the Maharaja of Alwar that Peterson catalogued, and the collection of the Maharaja of Jammu and Kashmir in the Raghunātha Temple that Stein catalogued were both the products of collecting in the nineteenth century.[26] At the other end of the scale were the private collections of pandits that were retained by the families but no longer used, or were even abandoned, or sold for use as scrap paper.

Jealousy Revisited

Given these early modern features of the learned Sanskrit world that the collectors discovered, the "jealousy" or "aversion" that they encountered might have another or additional explanation than one explicitly of resistance to colonial power. The Sanskritic cosmopolitan world had been a pronouncedly competitive one, in which access to a good collection was a necessity. In this light the protectiveness of owners might not be so surprising.[27] Private owners retained a sense of the value of the collection as a form of family capital. In this sense, their collections served as a repository for what made them who they considered themselves to be.

Here local contexts were extremely important. The family collection might have included copies of *sanad*s, *firmān*s or *nirṇaya*s, that is, royal or legal documents or decrees which pertained to the family's rights and privileges. It might also have included practical materials for the customary occupations of the family, even if these occupations were no longer the primary source of the family's livelihood.

The legacy of the distinctive early modern structure of the ecumene, with its nodes and networks and hierarchies, might also serve to explain why the intervention of key figures could make all the difference in persuading private owners of the virtue of showing collections to the visitors. For example, the *rajopadhye*, that is, the principal intellectual at the court of the Maharaja of

[26] (Peterson 1892) (Stein 1894).

[27] I shall refrain from comment here about the irony in the current experience of researchers in Sanskrit studies who find that the government collections created by the efforts of these frustrated searchers are sometimes now themselves protected with the same jealousy by their custodians.

Indore, helped S.R. Bhandarkar to see the collections of other pandits resident in that city.[28]

One of the four social settings has been left out in the preceding discussion, that is, the religious movements or *sampradāya*s. As we have seen, the heads of the Jain monasteries and temples were very reluctant to show their materials, and harboured the worst suspicions about the collectors' intentions. When Peter Peterson visited Pātan to try to see the collection that was said once to have belonged to the twelfth century Jaina monk and polymath Hemacandra, his attempt "failed, as all previous attempts have done. The owner or guardian was absent; and before leaving he had not only locked the door of the treasure he loves too well, but, to make assurance doubly sure, had run up a brick wall in front of it."[29]

The followers of the Hindu teacher Madhva were even more reluctant, and came in for very harsh treatment in the reports. In the very first report of a tour, Bühler called them "the most bigoted and illiberal of all. Though a number of them were willing to talk with me on the secular branches of Sanskrit letters, such as Nyâya, Law, &c., they refused altogether to discuss their Vedânta, and to part with or show any of their books."[30]

Indeed, during this period of search, certain of the *sampradāya*s were never persuaded. It is no coincidence that their texts were much less well known in the academic world, despite their cultural importance, and have been subject to much less serious study for the better part of the century that followed.

Three Early Modern Sanskrit Collections

In all of the ways that have been discussed, the early modern cosmopolitan world of Sanskrit played a constitutive role in the formation of our modern Sanskrit research libraries, and of our understanding of those libraries.[31] Therefore it would be very desirable to examine collections that were created by Sanskrit scholars during the early modern era. But there are difficulties in locating collections that still survive in their early modern form today; it is difficult even to locate a list of the titles of any collection that dates from the

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[28] (Bhandarkar S. 1905, 3–4).

[29] (Peterson 1895, 2). Peterson further remarks that the owners or custodians of many of the dozen or so ancient "bhandars had, in anticipation of [R.G. Bhandarkar's] visit, removed their persons or their books from Patan" (ibid., 3).

[30] (Bühler 1868, 320). This depiction is all the more surprising, given that Bühler was not usually so harsh. In one report R.G. Bhandarkar said of the followers of Madhva that they "are very superstitious and do not allow their books to be seen by others" (Bhandarkar 1882, 3).

[31] It should be noted that European and American institutional collections of Sanskrit sources took their shape during this same period in the later nineteenth and early twentieth centuries, often supplied by the same collectors who were doing the work for the British government in India.

period.[32] This is because of the instability inherent in collections, as has been described: normal wear and tear, their re-use and re-distribution, their partition among sons as part of their inheritance, the fact (ubiquitous and iniquitous) that loaned books are not always returned, or the fact that manuscripts were disposed of upon the death of the owner by immersion in a river, or the fact of forcible accessions, or even of looting.[33] The catalogues of the colonial period, furthermore, do not in general specify the entire contents of a single collection, given their selective interest in the old and rare.[34]

Some collections that were produced and used in that period still survive nevertheless, sometimes with only the additions (and subtractions) of descendants of the same family. I shall consider three such collections of Sanskrit manuscripts. Two collections belonged to families that maintained their hereditary profession over the centuries; the third belonged to a Rajput king, Anūpasiṃha, a celebrated bibliophile of the seventeenth century.

The two family collections that will be discussed here, the Vyas-Weisz and the Toro, have not been used in the modern historiography of Indian science. They provide evidence of what might have been missed in the past; that is, the shaping of a collection to conform to occupational practice, and the historical setting in which the members of a family worked. A study of these collections also affords glimpses of the transition from early modern to modern.[35]

Vyas-Weisz

For reasons that will become clear as we proceed, I begin by devoting some space to describing the history of the Vyas-Weisz collection, and how it came to bear its hybrid name. The Vyas-Weisz collection is in the possession of the

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[32] The famous exception is the list of the collection of the prominent seventeenth-century Banaras-based figure Kavīndrācārya Sarasvatī, edited in (Sastri 1921). About this list see (Gode 1943–1944). Items that belonged to Kavīndra ended up in Anūpa's library. See below.

[33] S.R. Bhandarkar records the widow of the owner of one collection reporting that the grandmother of the ruler of Indore had about a hundred manuscripts from her husband's collection removed at the time of his death (Bhandarkar S. 1905, 4). He also reports that many manuscripts "which consist of loose leaves are sold, as so much waste paper, to grocers and sweetmeat sellers, and the leaves part to meet no more" (Ibid., 17). The looting of a royal library in Jammu for the sake of the silk covers is recounted in (Kunte 1881, 3). The collection had belonged to Ranjit Deva, ruler of Jammu (or Jambu in Kunte's spelling). The sack of the city had been carried out by Maha Singh, father of Ranjit Singh the last independent ruler of the Punjab, in 1781.

[34] "In going over the collections in this place and elsewhere it was a weariness over and over again to come across the same works on modern Nyāya and Grammar and on Astrology and Mantra, which are not of much importance in the eyes of a scholar" (Bhandarkar S. 1905, 4). Numerous comments along the same lines appear in the other reports, if not so petulantly expressed.

[35] The following provides only an initial, provisional picture, as complete and descriptive catalogues of the two family collections are not yet available.

Bodleian Library in the University of Oxford. It is a collection of Sanskrit manuscripts, with some manuscripts in Gujarati and other North Indian languages. It does not have a complete catalogue. David Pingree produced detailed notes for a significant fraction of the collection; for the remainder we have only a rough hand list. The discipline and profession of *jyotiḥśāstra* is the best represented subject in the collection, comprising astronomy, mathematics, calendrics, astrology, celestial divination, and related ritual practices, but there are also texts that belong to the general education in Sanskrit.

The interest of the collection is that it represents the patterns of collection and use by an Indian family over fifteen generations and four centuries. Because of the way that the collection came into the Bodleian's hands, nothing has been filtered out by a dealer or by an accessions specialist.

History of the Collection

The collection has been in the possession of the Bodleian since the second World War, but was only rediscovered in 1986 by the Indian Institute Librarian at that time, Jonathan Katz, who pieced together the following history.[36]

The collection was the property of a Gujarati family of astronomers/astrologers, whose name was Vyas. The Vyas family lived for a long time in the village of Lakthar or Lagatera, in Kutch. In the 1930s, the family decided to send a son to study medicine at the University of Vienna. As a safeguard against unexpected expenses, they gave him part of the family patrimony, in the form of the family manuscript collection, which, they correctly supposed, would be considered valuable by Austrian or European book dealers, libraries, or scholars.

At some point the collection was then sold by Mr. Vyas to a Hungarian book dealer called Weisz. The Weisz family subsequently left Austria, probably for the usual sensible reasons that Jews left the German-speaking countries in the 1930s. Not all of the story is known here, but Mrs. Weisz turned up with the collection in Hove, in Sussex, in 1940.

Through various intermediaries, the collection was offered for sale to the Bodleian in Oxford, and was sent for inspection and evaluation by the Bodleian's Orientalist librarians. Meanwhile, before any decision was made in favour of purchasing the collection or not, a Bodleian "gnome" who loved to secrete things away so that only he would know where they were, only to produce them triumphantly when called for, hid the collection away somewhere, but then left service in the university. Other Orientalist librarians also went into military service at that time. Meanwhile, Mrs. Weisz and her intermediaries emigrated from the United Kingdom, and so the collection passed

[36] What Katz discovered about the collection is preserved in a file in the office of the Indian Institute Librarian in the Bodleian Library. My thanks to Gillian Evison for granting me access to this material.

out of knowledge, until 1986, when the box containing it was found by chance in the stacks of the library, by Jonathan Katz.[37]

This story has been told at some length because it demonstrates the unusual possibility that the collection represents. This is a collection that has not been subjected to the usual sifting processes that are a regular part of library accessions. The collection had not been purchased in 1940; it was simply stored away and forgotten for nearly fifty years. This means that the collection contains just the sort of ephemeral material to which Indologists do not usually have access: letters especially, but also lists of books and of ritual preparations, and, of particular value for the history of the exact sciences—astronomical tables, rough calculations, horoscopes, yearly almanacs, and so on.

Description of the Collection

When re-discovered, the collection contained approximately 350 bundles. By my count of the entries in the hand list there are approximately 1300 separate items contained in the bundles.[38] The manuscripts are copied on "country paper." The age of the manuscripts cannot be known in every case, but the oldest dated one (Vyāsa 115b—a manuscript of the *Aṅgavidyā*) is from the fifteenth century. The majority belong to the eighteenth and nineteenth centuries. Most of the copies appear to have been made by members of the family or by scribes working for them in the Kutch region of Gujarat.[39]

As has been mentioned the Vyas family were *jyotiṣa*s, that is, practitioners of the profession associated with *jyotiḥśāstra*, the 'exact sciences' in their Indic form, comprising astronomy, astrology, mathematics, divination, and so on. A large proportion of the manuscripts in the Vyas-Weisz collection, nearly 500 items, belong to the practice of *jyotiḥśāstra*, or *jyotiṣ*, in this broad definition. The proportion of the collection that pertains to the professional practice of *jyotiṣ* becomes larger if we count the items in the collection that belong to the "supporting belt" of knowledges and practices that formed part of the Vyas family's occupation as *jyotiṣa*s. Included here are descriptions and manuals for ceremonies appropriate to particular days of the ritual year (*kālanirṇaya*—ca. 35); ritual texts that explain how to perform rituals to appease malefic or weak planets that give trouble in a horoscope; or texts that propitiate the deities that rule over each planet, especially Hanumān, who rules over the most malefic planet, Saturn (*śānti* and *pūjā*—20). There are texts that describe vows, such as

[37] In the late 1980s Katz spent some time reconstructing the story told above. He attempted to trace Mrs. Weisz, her intermediaries, or any of their descendants. The surviving Weisz family members by then lived in the US or Israel, or South America, and were eventually remunerated by the Bodleian for the value of the collection at the prevailing rates, after appraisal by the antiquarian bookseller Bernard Quaritsch.

[38] The estimate in 1987 by the appraiser was roughly 1500 items.

[39] There are some manuscripts from further away places such as Ahmednagar (Vyāsa 132) and Jodhpur (Vyāsa 29).

fasting, that a person would undertake to ward off the outcomes of bad predictions or to survive dangerous moments (*vrata*—25); texts that lay out other rituals that would fortify a client more generally, along with lists of materials to be used in performing all such rituals (all in all ca. 200), and prayers in praise of deities who might be thought to intervene more generally in the life of an afflicted worshipper (*stotra*—95).[40] It is only the remainder of the collection that contains texts of other Sanskrit arts and sciences; grammar / linguistics (*vyākaraṇa*) is particularly prominent, as are literary works of poetry and drama.

To speak in very general terms, then, the picture of the intellectual life of the Vyas family that we can derive from these materials is that of "end users," that is, of hereditary practitioners who offered a full range of astronomical and astrological services, but not of scholars among scholars, and not of creators of new theoretical texts within their own discipline. No doubt many early modern collections that belonged to families of *jyotiṣa*s had the form that the Vyas collection had.

Practices

We can say something more about the particular areas of astronomical and astrological practice in which the Vyas family were especially proficient, by analyzing the *jyotiṣa* part of the collection a little further. Judging by the materials that survive, the family were chiefly occupied with creating calendars and casting horoscopes.

The form of the calendar that members of the family, like other *jyotiṣa*s, produced, is called a *pañcāṅga* or 'five-limbed' almanac. Each page of a *pañcāṅga* represents a lunar fortnight, and gives at the minimum the lunar day (*tithi*) as a thirtieth of a synodic month; the civil day or weekday; the constellation (*nakṣatra*) occupied by the moon (from a sequence of 27); the lunar half-day or half-*tithi* (*karaṇa*); and the *yoga*, or "anti-*tithi*," that is, the total increase in longitude of the sun and moon, measured in collective intervals of 13° 20'. The latter three entries especially would be used for determining auspicious and inauspicious days and moments. A *pañcāṅga* could also include mention of the entry of the sun into a new zodiacal sign, intercalated lunar months, tables of planetary longitudes at the beginning of the fortnight, times of sunrise and sunset, and day-length.

The materials that predominate in the *jyotiṣ*-related part of the Vyas collection are in the first instance texts that support the creation of *pañcāṅga*s for a particular longitude and latitude and lunar-solar year. These are texts called *karaṇa*s—handbooks of ready-to-use formulas, produced by canonical authors in the various schools of *jyotiṣ*, together with the *koṣṭhaka*s or tables that go

[40] Thus roughly 880 of 1300 items in the collection are directly related to the family occupation as astronomers/astrologers.

with them, in which *tithi*s, *nakṣatra*s, planetary longitudes and so on are presented ready-made and calculated out according to a particular *karaṇa*. Then there are also copies of *pañcāṅga*s for particular fortnights, months, and years, in various stages of completeness. The collection also has more specific and ephemeral tables of planetary longitudes, lunar days, *nakṣatra*s, and so on, which were generated from the *karaṇa*s and *koṣṭhaka*s, and which were probably calculated by members of the Vyas family. Stray pieces of paper with calculations on them are preserved in the collection. The planetary longitudes derived from the tables would be used for casting horoscopes and for other forms of astrology, in particular catarchic and interrogational astrology. In numerical terms, there are ten copies of *karaṇa* texts, 65 manuscripts of *koṣṭhaka*s and other tables, and at least forty loose pages of calculations of different types.

In addition to the calculatory material, there are texts for catarchic astrology, i.e. for choosing an auspicious moment at which to undertake an activity, and divinatory texts for the same purpose. Texts that provide knowledge about the quality of a particular moment are attended by supporting ritual procedures—appeasements of planets and their ruling deities, explanations of the ritual calendar and especially of virtuous days. There are some texts that describe tantric or hermetic practices, but the Vyas family does not seem to have gone in for the practices of initiates into these esoteric arts, and have only some exoteric texts for the propitiation of powerful tantric deities.

As far as this collection goes, therefore, there is not a great emphasis on the "landmark texts" of the discipline, that it to say, the *siddhānta*s or treatises that discuss planetary theory, time cosmology, and the derivation of the basic parameters of a school or thought (*pakṣa*).

Jyotiḥśāstra as a discipline did not go in for the creation of encyclopaedic works to the same extent as many of the other *śāstra*s had done in the late medieval period.[41] The Vyas family did have copies of some of the legal and ritual encyclopedias (*nibandha*), as these were relevant to their practice. Of greater interest is that they collected the astronomical works of the rival schools of *jyotiṣ* that were current in the north during their period– Brāhma, Saura, Dṛktulya, and Gaṇeśa. The Gaṇeśa school originated in Gujarat in the sixteenth century, and represented one of the most innovative developments of early modern *jyotiḥśāstra*. The Vyas collection has a noticeably large number of copies of texts derived from this school of thought, for example the *Tithicintāmaṇi* and the *Grahalāghava*.

In the older occupational manuscripts there is nothing but Sanskrit used, but this shifts over into a mixture of Sanskrit with Gujarati in materials that can be dated to the late eighteenth century and after.[42] We can detect in this shift one feature of the transition from early modern to modern. The collection also

[41] But see below, under the Anūpa collection.

[42] See for example Vyāsa 13, which gives Gaṇeśa's *Tithicintāmaṇi* in Sanskrit, and the commentary in Gujarati, or Vyāsa 54 (dated 1781) which gives examples and tables for the Sanskrit *Tithikalpadruma* in Gujarati.

includes literary works in Gujarati, (for example the *Oṣāharaṇa* and the *Māṃmeru*,) as well as in other modern Indian languages. There are also letters and other family documents in Gujarati.

The members of the Vyas family are well represented in the collection as scribes and owners. Not many of the works in the collection have members of the family as their proper authors, but this is because of the general tendency to focus on practical, calculatory materials. Hence there are many tables which are derived from *karaṇa*s and which are the product of members of the family, but no member of the family wrote a *karaṇa* himself.

Of particular note are Raṇachoḍa Vyāsa, son of Vāsudeva, who flourished in the late seventeenth century, and who is noted as the scribe or owner of at least ten manuscripts, and Śivaśaṅkara Vyāsa, son of Prabhujī, who flourished a hundred years later, and who is noted as the scribe or owner of at least fifteen manuscripts. It is also worth noting that Raṇachoḍa collected and copied primarily astrological texts, while Śivaśaṅkara was more concerned with technical calculations, especially with tables for producing almanacs. The oldest manuscripts in the collection were not copied by any member of the family, and there are a number—mostly having to do with the ritual calendar—that belonged to members of a monastic or priestly group.[43] As far as can be judged from the manuscripts, the family had no connection with any ruling family, and no connection with any particular court.

Thus the emphasis of the collection is on practical applications. This emphasis is borne out further in the treatment of some of the canonical texts in the collection, which have materials interleaved by members of the family. Thus for example, the collection's copy of the *Tithicintāmaṇi* of Gaṇeśa consists in a text of 73 verses. In fact, the *Tithicintāmaṇi* in its canonical form has only 18 verses. A member of the family has copied in additional verses from other sources as relevant. A certain number of the verses are taken from another work by Gaṇeśa, the *Grahalāghava*, but many more are as yet unidentified.

Now, what is early modern about this collection? The most notably early modern feature is the way in which the Vyas family, though living on the very edge of the Sanskrit-based world, at the far end of coastal Gujarat, nevertheless continued to collect and use materials that were contemporary and produced elsewhere. For the general pace of circulation we might consider only Vyāsa 113, a work on solar and lunar eclipses that was copied in 1718 CE., and that is based on the *Bhramaṇasāraṇī* of Trivikrama, a work composed in Nalinapura in 1704. While the family often relied on the texts of the Gaṇeśa school, they maintained a broad collection of *karaṇa*s and their derived tables, which literature is largely a phenomenon of the early modern era. The collection includes copies of the *Kheṭasiddhi* and *Candrārkī* of Dinakara, composed in 1578 (Vyāsa 14); the *Tithikalpadruma* of Kalyāṇa, composed in 1605 (Vyāsa

[43] For example Vyāsa 115 which belonged to Ācārya Prabhurāma and then Ācārya Ruganātha.

68), the *Jagadbhūṣaṇa* composed in 1638 (Vyāsa 70); the *Ānandakaraṇa* of Keśava, composed in 1699 (Vyāsa 28—copied in 1716) among others.

Summary

In this collection astronomical and astrological practices are primary. There are few canonical texts, and they are preserved quite often in a "home copy" form, that is, with additional materials and tables and examples and solutions copied into them or attached to them. The collection also features many ephemeral materials that are "ready-to-hand," though there is not space to treat these materials here. Even the provisional study of the collection at this stage enables us to revise our picture of the life of the knowledge systems associated with Jyotiṣ, though we cannot yet do it with a great deal of nuance.

Toro

The Toro collection bears out this point about the emphasis on the practical over the canonical. This is a collection of 631 manuscripts (almost all Sanskrit, a few Marāṭhī,) that was given to the Bhandarkar Oriental Research Institute in Poona (or Puṇe) in the 1980s by a family of Brahmins called Toro. The librarian of the BORI at that time, V.L. Manjul, deserves the credit for securing the donation. He also produced a detailed handlist in Marāṭhī of the manuscripts.[44]

When they made their gift, the Toros had been living for some time in Wai, a pilgrimage town along the headwaters of the Kṛṣṇā river in what is now Satara district in Maharashtra. Wai had been expanded and rebuilt by the Maratha and Peshwa rulers of the seventeenth and eighteenth centuries. For most of the active period recorded in their manuscripts, however, the Toros had been a prominent Brahmin family based in the city of Kolhapur or Karvir, one hundred miles south of Wai. Kolhapur served as the capitol for the kingdom of a branch of the Bhosle Maratha family from the seventeenth through the twentieth centuries. Many manuscripts in the Toro collection record that they were copied in Karvir, though others were produced elsewhere in Maharashtra, and a few in Banaras.

The manuscripts in the collection are made of paper. They date mostly from the eighteenth and nineteenth centuries, though some manuscripts were produced more recently. There are more than fifteen members of the extended Toro family, spread over at least five generations, who had a hand in the collection, as authors, scribes, and owners. Especially prominent are the authors Govinda Dīkṣita Toro (fl. ca. 1760 C.E.), Rudradeva Toro, son of Nārāyaṇa, (fl. 1787 C.E.), who composed a compendious work of dharmaśāstra and ritual called the *Pratāpanārasiṃha*, and Ananta Dīkṣita Toro (fl. 1814 C.E.) who appears to

[44] My thanks to V.L. Manjul for generously providing me with a copy of the handlist.

have been the crucial figure in building the collection as it now survives. There are about seventy manuscripts in the collection, for example, that once belonged to another *śrautī* called Jagannātha Dīkṣita Bāpaṭ, who also lived in Kolhāpur. He had copied many of these manuscripts himself. It would appear that it was Ananta who secured these manuscripts, and those of other families as well, for his own family's collection.

The collection supported the Toros' occupation as the performers of Vedic *śrauta* rituals. *Śrauta* rituals were the most ancient and prestigious of Indian ritual practices, though rarely performed. Their performance required a great deal of specialized training and experience. Because of their expense, their performance would usually call for the support of a patron. A royal or princely patron would be needed for the more elaborate rites.

Era and Context

The *śrauta* rituals were of considerable interest to Hindu rulers of the early modern period, as their performance was part of a model of kingship of a classicizing or traditionalizing sort. A ruler who chose to sponsor Vedic ritual within his kingdom was not doing so in order to embrace popular religious trends. The popular religious currents flowing through South Asia in this period were emotional and devotional, and tended to affirm the value of social levelling.[45] Performing *śrauta* ritual sacrifices to the Vedic gods of old, on the other hand, reaffirmed the ideal of the fourfold social hierarchy as it had been proclaimed by the ancient Brahminic sages.

The Peshwas, nominally stewards of the Maratha kingdom, and their royal counterparts the Marathas, were in the eighteenth century rulers of an extensive domain in Northern and Western India. Both Peshwas and Marathas were interested in performances of Vedic rituals for their restorationist implications. The Maratha rulers of Kolhapur were also interested in their performance as a way of confirming and reinforcing the social acceptance of their status as members of the "twice-born" or Veda-eligible classes. One manuscript in the Toro collection explicitly mentions some of the Peshwas and Marathas as patrons or donors.[46] The Toros probably officiated at rituals for the Kolhapur princes, though they did not hold a permanent appointment at court as royal minister or priest (*rājopādhye* or *rājapurohita*).[47]

The privilege of officiating as a priest at a Vedic *śrauta* ritual belonged only to Brahmins of proper training and standing, and in turn, performers of *śrauta*

[45] To a lesser extent tantric or hermetic practices were also spreading in popularity in the period.

[46] Toro MS 79, copied in 1692 Śaka or ca. 1770 C.E. includes reference to Shahji, Serphoji, Tukkoji, and other Maratha rulers.

[47] Rudradeva Toro's work entitled the *Pratāpanārasiṃha* was evidently dedicated to a ruler called Pratāpa Nṛsiṃha. None of the kings of Kolhāpur in Rudradeva's period bore this name, however. See below under the Anūpa collection for further examples of this practice of naming texts after the patron.

sacrifices for royal patrons had an unsurpassed standing within the traditional social world of Brahmins. The Toro collection is devoted almost entirely to ritual practice of this specialized, *śrauta* sort. It barely includes other ritual material even for the performance of the equally Vedic, but less prestigious, household or *gṛhya* rites. In this sense the collection is not terribly cosmopolitan or comprehensive for the world of Sanskrit letters. The emphasis is rather on being comprehensive for the *śrauta* practices, in the performance of which the Toros had decided to specialize.

Vedic Practices

The interest of the Toro collection for the historian is twofold: the collection overwhelmingly favours practical ritual literature over canonical Vedic literature, and there is an evident commitment to collecting texts of three independent ritual schools in full detail. The Toro collection includes manuscripts of the canonical Vedic texts, especially those of the recension of the Kṛṣṇa Yajurveda, and more specifically of the Taittirīya branch of that Veda. By family tradition the Toros learned the Taittirīya recension by heart and transmitted it to their sons and students. The Toro collection thus contains manuscripts of the Taittirīya *Saṃhitā*, *Brāhmaṇa*, *Āraṇyaka*, and *Upaniṣad*, the revealed or *śruti* texts.

However the Toros kept manuscripts of more explicitly ritual texts in vastly greater numbers. There are manuscripts of the *śrautasūtra*s, or ancient and foundational ritual texts, but by far the majority of the collection is made up of copies of *prayoga*s and *paddhati*s, that is, of manuals of ritual performance. The Toros kept the grand encyclopaedic handbooks of performance that had been composed by earlier and contemporary authors, such as Tālavṛntanivāsī, Gopāla, Keśavasvāmī, Candracūḍa and Deva Ananta. A number of such high-brow *śrauta* practical texts were the compositions of members of the Toro family itself, esp. of Govinda and Rudradeva. The family kept even larger numbers of the more practical, highly specific manuals for particular priests. Many of these were probably produced by the family, presumably for particular rites whose performance had been commissioned. Thus while the collection includes a total of about sixty manuscripts of the canonical Vedic texts, it includes 225 manuscripts of *śrauta* ritual manuals.

The second point of interest is that the Toros collected texts belonging not just to the ritual school or *caraṇa* to which they belonged, the Āpastamba school, but also to the Baudhāyana and Hiraṇyakeśī schools. These three ritual traditions of the Kṛṣṇa Yajurveda were all active in that part of India in those days: the Āpastambīs more prevalent in the southern Deccan, the Baudhāyanas on the Konkan coast, the Hiraṇyakeśīs in the center of Maratha country, in what are now Satara and Kolhapur districts.[48]

[48] My thanks to Frederick M. Smith for confirmation of this information by personal communication.

Therefore the interest of the collection is that the Toros maintained enough material to be able to perform rituals according to all three local ritual schools of the Yajurveda. This would be unusual for any but the most ritually engaged of specialists. Ordinarily a Yajurveda performer needed to be proficient in only one *caraṇa*. The Toros, on the other hand, had dozens of *prayoga*s according to each of these three schools, as well as a handful of texts from the Āśvalāyana and Kātyāyana schools.[49]

Another feature of some interest is the further specialization within the area of *śrauta* ritual. The Toros had in their collection a strikingly large number of manuals for performing *kāmyeṣṭi*s, that is, optional sacrifices that a patron would put on in order to achieve a particular desired result. The three rites especially featured in the collection are the *kārīreṣti*, which was thought to bring rain, the *mitravindeṣṭi*, to provide prosperity, territory, allies, and long life, and the *mṛgāreṣṭi*, a short section of the *aśvamedha* or imperial horse sacrifice, which was though to confer some of the same results of lordliness as the full rite.[50] All of these are rites that would be of interest to a ruler in the dry uplands of the Deccan. The *kāmyeṣṭi*s were, by comparison to the full Soma rites that the Vedas describe, relatively less costly to sponsor and less time- or labor-intensive to perform.

Non-*śrauta* Features

The Toro collection includes a smaller number of texts for non-Vedic religious performances, such as the texts of prayers (*stotra*), of the worship of Hindu deities especially of Śiva (*pūjā*), and of forms of ritual preparation for the performer, of a somewhat tantric sort (*nyāsa* and *kavaca*). Aside from materials for ritual practice, there are only about fifty manuscripts on other subjects, and these are all manuscripts on the subject of Vedic non-dualism or *advaita vedānta*. There are almost no other philosophical traditions represented, or legal literature. There is very little poetry or drama, very little devotional or hermetic literature, and very little of the exact sciences.

By comparison with the Vyas collection, the other noticeable absence is that of ephemeral materials. There are no lists of materials, letters from potential patrons or employers, or judgments or decrees. One wonders about the reason for the "cleanliness" of the collection in this sense, that is, whether the donors or the librarian at the Bhandarkar Institute might not have sifted such material out.

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[49] Here the numbers are only minimal; most prayoga texts in the handlist do not have their caraṇa identified. Many of the manuscripts that had belonged to Jagannātha Dīkṣita Bāpaṭ were ritual texts of the Hiraṇyakeśī school.

[50] See (Caland 1908, sections 180 and 183).

Summary

We get a sense of the use of this collection by the Toro family even from this cursory inspection. The Toros were highbrow ritual specialists. They maintained a profile as unusually learned and capable. One member of the family, Rudradeva, composed a work of law and ritual of the sort that was being composed and circulated by the great families of Deccani pandits in Banaras of the period, and Rudradeva's work enjoyed some circulation as well. Primarily, however, the Toro collection served their practical, professional needs as a family operating within the network of ritual specialists in the most prominent kingdom in the Deccan in the later early modern period, and serving even the rulers of the kingdom in a particularly honoured way.

The nature of the collection supports the findings concerning the Vyas-Weisz collection. Although the Toros were not *jyotiṣa*s, they too maintained a collection whose primary purpose was to support the family occupation. In their collection too the practical or applied materials far outnumbered the canonical or "landmark" texts.

The heyday of their collection dates from the very end of the early modern period. Nevertheless the imprint of a distinctively early modernity is present on it. There are copies of the numerous authoritative and compendious works that were produced in the era, especially by Maharashtrian pandits in Banaras: Ananta Deva, Nārāyaṇa Bhaṭṭa, Dinakara Bhaṭṭa, Śeṣa Nārāyaṇa, as well as by Candracūḍa and Jagannātha Paṇḍitarāja.

It is a collection of paper manuscripts, some copied by the family, others produced by scribes, that belonged to an extended family which occupied a niche in the social economy of the end of the early modern period. I suspect that the prevalence of manuscripts of the optional sacrifices, or *kāmyeṣṭi*s is part of the early modern story as well, with an emphasis on goal-directed rituals rather than plain maintenance of past traditions.

Anūpa

The last collection that we will consider is a royal one. It belonged to the rulers of the princely state of Bikaner. The core of this collection was created in the late seventeenth century by Anūpasiṃha, from whom the collection derives its name. Anūpasiṃha, or Anūpa, was the Maharaja of Bikaner from 1669 until 1698. The Anūpa collection is unusual among the surviving libraries of Rajput princes for its extent and quality, and for its age. As mentioned above, many surviving collections of Rajput princes are the result of collecting in the nineteenth century, but the Anūpa collection is in large part the direct result of Anūpasiṃha's own seventeenth century bibliomania, even in the form in which it survives.

The Anūpa collection is unusually valuable for the light it sheds on the process of building a collection in the early modern period. There have been

two attempts at cataloguing; the latter attempt, carried out in the 1940s, produced a catalogue of the majority of the Bikaner palace library collection at that time.[51] In a recent study, David Pingree reconstructed the history of Anūpa's life as a bibliophile and collector, especially of scientific manuscripts.[52]

Even before his accession to the throne, Anūpa had become interested in the exact sciences. Upon his accession he named a court astrologer, or *jyotiṣarāya*. He also retained some skilled scribes and employed a *śāstrī* based in Banaras, whose name was Maṇirāma Dīkṣita, as a sort of intellectual-at-large.[53] At first Anūpa commissioned copies of the ordinary, landmark *jyotiṣ* works, but moved on to more unusual works as his knowledge increased.

Anūpa was an ally of the Mughal emperor, Aurangzeb, and as part of his service to the emperor he went on military campaigns in the south, against the Marathas, among others. While camped around cities such as Daulatabad and Bijapur he continued his collecting. In this way, he added texts to his library that were in more common circulation in the south.

In the end, Anūpa's collection amounted to nearly 10,000 titles. This was a very large collection for the period. It was also compendious in subject matter. Because of the skill of his scribes, especially a Brahmin called Mathena Jośī, the collection is still notable for the quality of its copies. The collection in the royal palace in Bikaner thus came to include what are in some cases the only known copies, or the only complete copies, of certain Sanskrit works. The collection covered not only the exact sciences, but most fields of mainstream, secular Sanskrit learning. It was especially strong in authors of the early modern period.

The collection continued as the core of the palace library in Bikaner. The manuscripts that were catalogued in the early twentieth century do not all date to Anūpa's day. Not all were his, and not all of his remain. Nevertheless the bulk of Anūpa's own collection is still there. It served as the model for Sawāī Jaisingh's (ruled 1700–1743) palace library in Jaipur. Indeed some of Anūpasiṃha's manuscripts ended up in Jaisingh's library.

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[51] (Mitra 1880) (Raja, Sarma, and Madhava 1944–1948). The latter catalogue covers 6682 manuscripts, roughly two thirds of the collection.

[52] (Pingree 1997). Pingree based his work on the catalogues, and analyzed the colophons of the manuscripts in the collection, which among other things indicate when manuscripts were copied, who was commissioned to copy them and by whom. His study is an example of the sort of history it is possible to reconstruct based on a properly detailed catalogue of a collection. I have supplemented his narrative from my own notes in what follows. Like him I will concentrate on *jyotiṣa* and *dharmaśāstra*.

[53] Maṇirāma probably visited Bikaner at times. In any case a good part of his own library ended up in the Bikaner collection, as did parts of the library of Kavīndrācārya Sarasvati, mentioned above.

On Being Comprehensive

By comparison with the Toro and the Vyas collections, Anūpa's library was much more comprehensive, over a broad range of subjects. This was by design. Anūpa and his collectors certainly valued rare works as such and sought them out in the interest of being comprehensive. For example, Anūpa acquired a copy of a fourteenth century south Indian astronomical work, the *Vārṣikatantra*, composed by Viddaṇa. This text was not widely known even in Anūpa's day. He then acquired what is now the only known copy of a commentary on the *Vārṣikatantra* by the south Indian author Tammaṇa, the only known copy of another commentary by Ballāla (who was the uncle of Vīrasiṃha, Anūpa's Jyotiṣarāya,) and copies of two other commentaries.[54]

On Being Early Modern

The Anūpa collection shows the intellectual activity that was current among early modern Sanskrit intellectuals in a number of different ways. As has been mentioned earlier, the early modern period was one of an intensification of circulation throughout South Asia: of personnel, ideas, technologies and texts, and this is reflected in the growth of Anūpa's collection.

The idea of having a court astrologer with the title of *jyotiṣarāya* appears to have come from the Mughals, and indeed, a number of the features of Anūpa's royal practice of astronomy, astrology, and time regulation were modelled on Mughal courtly practices. Anūpa's court astrologer, Vīrasiṃha, was a Brahmin from the Deccan plateau in southern India; to be more specific, he came from Kheṭa, a town along the Godavari river. There were clusters of Marāṭhī-speaking families of *jyotiṣa*s based on the Godāvarī river in this period, and they had become very active in the production of new astronomical and astrological texts. Vīrasiṃha, once installed in Anūpa's court, proceeded to introduce to Bikaner the astronomical and astrological texts and ideas that were being produced in the Deccan, especially in his part of the Deccan.[55] This was not merely a transfer of texts from one Indian region to another, however. The reach was broader. Since some members of the Deccani families of astronomers had relocated to Banaras, and were participating in the larger *ecumene* of Sanskrit intellectual activity of the seventeenth century, the circulation of their ideas into Bikaner brought with it the whole contemporary world of *Jyotiḥśāstra* of northern and western India. Especially noteworthy is the introduction of the new school of thought that originated in Gujarat, the Gaṇeśa *pakṣa*, which has been mentioned above.

In a similar way, the king collected for his library a large number of works of *dharmaśāstra*, that is, of moral, legal, and political discourse. The catalogue lists

[54] (Pingree 1997, 95).

[55] For details of these families, including that of Jñānarāja of Pārthapura, of Rāma of Golagrāma, see (ibid., 95–99).

roughly 1300 manuscripts under this subject. Of particular interest to Anūpa were the original or foundational, i.e. landmark works in this discipline, the *smṛti*s and their commentaries, especially commentaries contemporary to his own period (ca. 150 MSS); texts extolling the virtues of particular pilgrimage places and of particular days in the ritual calendar year (*māhātmya* —ca. 100 MSS); and, by far the largest number, *nibandha* texts or compendious and encyclopaedic works arranged around topics on which a ruler or a court might be required to render judgment (360 MSS).[56]

What is especially striking about the manuscripts of *dharmaśāstra* works in Anūpa's collection is how many of the works were products of Anūpa's own era, and more specifically the products of authors based in Banaras in that period. The most prominent Banaras-based family of Maharashtrian Brahmins, the Bhaṭṭas, are strongly represented. To mention just a few works, there are the *Dinakarodyota* and the *Prayogasāra* of Gāgā Bhaṭṭa (Anūpa 2405 & 2515), as well as the *Rājābhiṣekaprayoga* that Gāgā had composed in 1674 for the coronation of Śivāji—the ruler, incidentally, whom Anūpa had been sent to fight against in the south (Anūpa 2743); the *Rājābhiṣeka* of Kamalākara Bhaṭṭa, Gāgā's uncle (Anūpa 2562) and that author's *Śūdradharmanirūpaṇa* as well (Anūpa 1776); and two copies of the *Rāmakalpadruma* by Ananta Bhaṭṭa, Kamalākara's son (Anūpa 2567 & 2568).[57] Anūpa also owned works by many other Banaras-based pandits of his day such as Ananta Deva (Anūpa 2557), Mitramiśra (Anūpa 2595) and the polymath Bhaṭṭoji Dīkṣita (Anūpa 1684) who is best known for his grammatical works, but whose *dharmaśāstra* texts Anūpa collected as well.[58] In short, nearly every major author active in Anūpa's era, in *dharmaśāstra*, in astronomy/astrology, and in many other arts and sciences, is represented in the collection.

The Use of the Collection

What, then, was all of Anūpa's intensive collecting for? The general picture is one of a massive infusion of current ideas and texts. Given the extent of the effort necessary to build up a collection of this quality, it is not satisfying simply to conclude that this was a matter of a wealthy bibliophile indulging a private obsession. In fact, Anūpa was fulfilling the role of a particular version of the ideal ruler, in an unsurpassed way. This ideal was derived from a model developed by the Mughals. In this vision of the ruler's duties, he was, among other things, the patron of intellectuals from a range of cultural backgrounds. As the physician to the body politic the ideal ruler concerned himself with matters of concern to the collective health of the country. In the period these were

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[56] It should be noted that the numbers represented are of collections as a whole. Not every manuscript counted can be proved to have belonged to Anūpa.

[57] Anūpa 2567 was given to Anūpasiṃha in 1677 C.E. by the author's son.

[58] I give only single examples; there is a very long list of works and authors of *dharmaśāstra* that were contemporary with Anūpa's and represented in the collection.

conceived by the intellectuals as having to do with types of people, with the nature of their social identity and being, and with conforming the behaviour of society to the natural order of things, including the cycles of time within the kingdom.[59]

His comprehensive collecting would have served to establish Anūpa in an authoritative position to judge the issues presented to him. At the same time, it is clear that Anūpa was not indiscriminate in his collecting. He sought, rather, to build up the "intellectual infrastructure" at his court so that it could become a recognized center within the dynamic network of intellectual activity in Sanskrit that had joined up large parts of the Indian subcontinent in his era.

New Works Commissioned

The collecting, therefore, was linked to commissioning new work that was identified with his court at Bikaner. Anūpa was the patron of new treatises in *dharmaśāstra* and in *jyotiṣ*. These were not narrowly focused, practical texts, but vast, encyclopaedic texts, *nibandha*s, in *dharmaśāstra*, and the closest thing to their counterpart in *jyotiṣ*.

In Bikaner, Vīrasiṃha the *jyotiṣarāya* composed at least five works on behalf of Anūpa: among them was a *karaṇa* treatise called the *Anūpakaraṇa* (Anūpa 4411) with its epoch set at the day of Anūpa's consecration as king; and a vast work on numerous subjects related to time regulation called the *Anūpamahodadhi* (Anūpa 4412–19).[60] Rāmabhaṭṭa Hosiṅga wrote a *Tīṛthadarpaṇa* on pilgrimage (Anūpa 1781); a work on atmospheric omens, the *Anūpameghamālā* (Anūpa 4424), an enormous work on gifts, the *Dānaratnākara* (Anūpa 1866–617 pages in length) and other works on topics in *dharmaśāstra* and *jyotiṣa*.[61] Anūpa also commissioned work by Pantoji Bhaṭṭa (Anūpa 1649 etc.).

Not all of the paṇḍits creating works for Anūpa were based in Bikaner. Vidyānātha, a south Indian Brahmin, appears to have worked for Anūpa initially while the Mahārāja was appointed by the Mughal emperor Aurangzeb to be the governor of Adoni in the south.[62] Vidyānātha contributed large sections to a *nibandha* of *dharmaśāstra* that Anūpa commissioned, the *Anūparatnākara*, or "Jewel-mine of Anūpa." Vidyānātha contributed a section of this work that amounted to 850 pages in one manuscript (Anūpa 2674). Another author, Ananta Bhaṭṭa, produced the pilgrimage section of the same work, the

[59] See (O'Hanlon 2007) (Alam 2004) (Bayly 1998).

[60] There is also a *Pañcāṅgabhūṣaṇa*, a work on *pañcāṅga*s (Anūpa 4822); a work on catarchic astrology called the *Muhūrtasañjīvana* (Anūpa 4978); and a work on eclipses, the *Grahaṇasādhana* (Anūpa 4528) (Pingree 1997, 96).

[61] It is worth mentioning here a lengthy work on dream divination, the *Anūpakautukārṇava*, that Rāmabhaṭṭa wrote. The manuscript is 1558 in the catalogue of 1880, and is 423 pages long.

[62] (Pingree 1997, 100). This was a diamond rich area south of the Tuṅgabhadrā river in what is now Andhra Pradesh.

Tīrtharatnākara (Anūpa 1790–1822). Vidyānātha also produced an even longer work on rituals for the appeasement of malefic planets and other noxious influences, the *Śāntisudhākara* (Anūpa 2230–1097 pages.)

By far the most prolific author on Anūpa's behalf was Maṇirāma Dīkṣita, his *śāstrī*-at-large, who was based in Banaras, and who was the author, among many other things, of another vast encyclopedia or *nibandha* of *dharmaśāstra*, the *Anūpavilāsa* or "Anūpa's Recreation," which is available in many manuscripts in Anūpa's collection, and elsewhere in north India (Anūpa 2321–4, etc.).[63]

Sometimes manuscripts of the works that Anūpa commissioned, especially those that were named after him, attributed the authorship to Anūpa himself.[64] Many rulers of the period who were the patrons of compendious works of *dharmaśāstra* and *jyotiṣa* had their names put into the title, and often the impression was given that the ruler had contributed to the work as an author as well as patron. In Anūpa's as in some other cases, it is entirely possible that he did so. The person who set the example for this sort of relationship between patron and author was Ṭoḍar Mal, a Hindu minister in the court of the Mughal emperor Akbar. Ṭoḍar Mal commissioned a vast legal, ritual, and astronomical treatise that is usually known as the *Ṭoḍarānanda*, the "Bliss of Ṭoḍar."

Uses of the Library

Anūpa's collection, then, served state purposes in a distinctively early modern way, through supporting the production of Anūpa's own encyclopaedic works. The genre of the *nibandha* was particularly dependent upon the quality of the collection that informed its author. The authority of the *nibandha*, especially in the early modern period, derived from being comprehensive. This was demonstrated by citing large numbers of sources, both contemporary and ancient. Indeed the authority of the *nibandha* was in this period almost numerically determined: the more sources cited, the more authoritative it was taken to be.

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[63] There is a copy of the *Anūpavilāsa* in the Vyas / Weisz collection (Vyāsa 143). In the Anūpa collection there was also Maṇirāma's lengthy work on catarchic astrology, the *Anūpavyavahārasāgara* (Anūpa 4426). Anūpa was the patron of other authors in Banaras for more specific treatises as well. For example he requested Nīlakaṇṭha Caturdhara to compose a commentary explaining in more comprehensible terms the chapters of a tantric treatise, the *Śivatāṇḍavatantra*, that described the uses of magic squares of orders three and four. See (Minkowski 2008). In turn, Maṇirāma, who produced many summaries and commentaries for Anūpa, wrote a synopsis of Nīlakaṇṭha's work on magic squares, as well as of his commentary on the *Mahābhārata*. Indulging his interest in large numbers, Anūpa also commissioned a Bhadrarāma Homigopa to compose a ritual manual for a rite in which one could make ten thousand, a hundred thousand, or ten million offerings into the ritual fire, the *Ayutalakṣakoṭihomaprayoga*, No. 788 in the 1880 catalogue.

[64] For example, manuscripts of the *Anūparatnāvalī*, which is probably the same thing as, or an excerpted version of, the *Anūparatnākara* mentioned above, list Anūpa as the author (Anūpa 2315–17).

Since most of the works that Anūpa commissioned are still not published, it is difficult to go much further in describing specifically how the library was used. We have already seen, however, that Vīrasiṃha collected copies of the *Vārṣikatantra* and its many commentaries. Pingree has surmised that it was only then that Vīrasiṃha produced a revised version of the *Vārṣikatantra*, based on the materials he had assembled. It was this revised *Vārṣikatantra* that circulated more widely in subsequent centuries.[65] One could suppose that many other works commissioned by Anūpa similarly depended on reference to the works made available in the collection, but it is not possible to go further given the current state of our knowledge.[66]

In summary, Anūpa's collection served to connect his court at Bikaner, an outpost on the very edge of the Rajasthani desert, to the continent-wide currents of intellectual activity of his period. Anūpa saw his collecting as part of his royal role as ruler, as learned patron, and scientist. He was explicitly interested in collecting the recent output of the Banaras-based paṇḍits from the Deccan, who served as the gold standard for intellectuals in Anūpa's day. Anūpa had a number of them in his employ, though they remained in Banaras.

Comparison with Vyas and Toro

By comparison with the two family collections that we examined earlier, the Anūpa collection is distinctly different. Many of the differences are unsurprising given the vastly greater resources available to Anūpa as the chief collector. His collection is much larger, much more inclusive of a range of subjects, and furnished with unusually well-made copies. Anūpa collected works in languages other than Sanskrit, probably for the same reason. Like the Toro collection Anūpa's came to absorb other collections, though on a much larger scale, in Anūpa's case that of Maṇirāma and at least in part of Kavīndrācārya.

Anūpa tended to collect landmark or theoretical treatises, rather than the more practical sorts of materials that dominated the collections of the Toro and the Vyas families. Anūpa had an explicit interest in rare works, was interested in collecting over a much broader range of arts and sciences, and even commissioned new works on a grand scale. The collection was not simply for display, but was used to put Anūpa's court on the map of early modern India, for participating in the intellectual discourse on the political, moral, scientific, and ceremonial topics that were of greatest vitality in the period.

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[65] (Pingree 1997, 95).

[66] One might mention here Anūpa's attachment to the performing arts, especially singing. He had a *saṃgītarāya*, chief musician, at court, and collected avidly in this subject as well.

Conclusion

By way of conclusion let us return to the two questions that were raised at the outset, under "The Application in the case of India," about the pre-modern "indigenous" use of collections and about the role of modern collections in shaping the scholarly understanding of pre-modern disciplines. The foregoing study has been necessarily provisional, but makes it clear that when it comes to the historiography of South Asia these two questions are closely linked, and form part of the larger history of Indian modernity. For South Asian historiography, furthermore, the early modern is the crucial period for understanding the linkage of pre-modern with modern collecting and intellectual practices.

We have seen that the creation of modern collections, while continuing many of the intellectual protocols of the past, placed an emphasis on securing old and rare disciplinary treatises. In older, family collections, on the other hand, the emphasis had often been on lesser, ephemeral, practical material that was made "ready-to-hand." The distinction is not one purely between modern and pre-modern, however, for certain royal collections that predate the modern era placed value on acquiring rare texts for their own sake as well.

A third question that we have not considered is closely related to the two that we have. This has to do with the "cartography of the disciplines" that was embedded in the collections and their uses. That is, how were disciplinary boundaries defined and understood? What were their arrangements and categorizations, implicit or explicit? Space does not allow a discussion of matter here. I can only gesture in the direction of an answer, in which the history of intellectuals in the early modern period plays a role as well.

As we have seen, the scholars who built the modern collections in India in the nineteenth century were all educated in the indigenous Sanskritic cartography of the disciplines, and sought to build their collections according to their understanding of the disciplines as they existed. The headings in most of the catalogues that they produced were Sanskrit terms for the categories of knowledge, as these had been enumerated within the tradition, self-consciously, for many centuries.

But it is also true that the Sanskrit knowledge systems were not static in their constitution, neither in the subjects they covered, nor in the manner in which they were articulated with each other. In the early modern period in particular the *śāstra*s underwent a searching re-consideration. As we have seen, this was an era of synthesis and of the creation of compendiums of all knowledge. There were new doxographic works, and there were new independent essays on the subject of disciplinary cartography. The most well-known of the independent essays is the *Prasthānabheda*, or "Organization of the Foundations," by the seventeenth century polymath Madhusūdana Sarasvati. The *Prasthānabheda* attempted to classify all the disciplines and genres of Sanskrit textual production, especially of the *śāstra*s, and to describe their interrelationships. It attempted to take old enumerations and cartographies and to map them onto

the same scheme. The *Prasthānabheda* is not a unique document, but reflects, rather, the general interest of Sanskrit intellectuals of this period in the classificatory question.

In practice, furthermore, there were inevitably murky places on the map of knowledge forms. This was, and is, especially so at the more practical end of the range of materials. Thus a *tithi-māhātmya* text, on the good effects that derive from performing the rituals proper for a particularly auspicious lunar day, might reasonably be classified as part of the *jyotiṣ* or astronomical discipline, or as *dharmaśāstra*, or as a text of extolment (*māhātyma*,) or as belonging to a looser category of ritual text (*prayoga*). And indeed, in the catalogues of the collectors, the same or closely related texts were sometimes assigned to different headings.

In short, there is a great deal more that can be learned from the collections about the indigenous and exogenous classification of Indian knowledge, and in more general terms, about the history of Indian intellectuals.

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The French Jesuit Manuscripts on Indian Astronomy: The Narratology and Mystery Surrounding a Late Seventeenth – Early Eighteenth Century Project

Dhruv Raina

> *Other religious figures have combined these two features: at the same time that they seek to convert the Indians to the Christian religion, they also describe the Indians' history, their customs, their religion, and thereby contribute to a knowledge of them. . .They form one of the two main groups of authors to whom we owe what knowledge we now have concerning ancient Mexico; among them were representatives of various religious orders, Franciscans, Dominicans, Jesuits.*
>
> (Tzvetan Todorov 1984).

Jesuits studies, it has been pointed out, is a rapidly growing field of interdisciplinary research within the domain of modern history, and yet the historiography of the Jesuits and Jesuit missions in India is a sadly neglected field.[1] This essay does not intend to correct that omission, but addresses the collection of Sanskrit and Tamil manuscripts and the documentation of the sciences of the South Asian region initiated by French Jesuits in the late seventeenth and early half of the eighteenth century. This activity was spurred on by a variety of ideological motivations and framed by a set of social technologies. The essay is

This essay is based on a lecture delivered at a Workshop on the History of Science organized at the Indian National Science Academy in March 2005. The text was subsequently modified and presented at the Workshop Bibliothèques, encyclopédies, musées, archives : la constitution des collections qui ont fourni ses sources à l'histoire des sciences, Paris, 4–5 Avril, 2005. I thank Jean-Marie Lafont for his timely help with Omont's catalogue, Hélène Chollet for correcting my reading of Duchamp's manuscript, Florence Bretelle-Establet, Karine Chemla, Agathe Keller and Christine Proust for their comments on earlier drafts, Ines Županov whose work has deeply influenced this essay. The usual disclaimer applies.

[1] (Županov 2005, 2).

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F. Bretelle-Establet (ed.), *Looking at It from Asia: The Processes that Shaped the Sources of History of Science*, Boston Studies in the Philosophy of Science 265, DOI 10.1007/978-90-481-3676-6_4,

divided into three parts; the first part discusses the beginnings of the Jesuit writings on Indian astronomy and the influences on the form of their writing. It fleetingly indicates the continuities and departures between the early seventeenth and eighteenth century narratologies. The second part discusses a Jesuit manuscript and raises the question concerning the absence of Sanskrit and Tamil astronomical and mathematical texts in the Jesuit collection. This mystery is explicated in terms of their dialogical practices that were given form by their narratology. In other words, it is being suggested that the collection practices were in a way dependent upon the narratology or the writing practices. The third part raises the issue of the influence of the Jesuit project on British Indology. In particular, it indicates where and how the Jesuit project shaped the collection of Indian mathematical and astronomical manuscripts.

The Beginnings of France's Engagement with Indian Astronomy

The early eighteenth century has been considered the formative period for the emergence of the discourse on the Orient while the latter half acquires significance for the formation of the discourse on colonialism. During the eighteenth century European writing on India comprised a network of "intersecting and contending discourses", and was preoccupied with a wide range of questions about authority.[2] The representations of India in this writing are naturally very "diverse, shifting, historically contingent, complex and competitive" and were shaped by "national and religious rivalries, domestic concerns", and the cognitive or intellectual cultures of the respective interlocutors.[3] It has been argued that until the eighteenth century it was possible to speak of a European tradition of writing about India that differentiated into several national traditions by the middle of the eighteenth century. The one we look at here is specifically the French Jesuit discourse on India.

European writing on India following the discovery of the sea route has been categorized into three distinct genres and periods.[4] The writings of the Christian missionaries in India, belonging to numerous orders, in the seventeenth and eighteenth century comprise one of these genres. This writing itself is internally differentiated, consisting of letters recording the progress of missionary activity in India, as well as the writings of Jesuit missionaries resident in India on Indian philosophy, religion and culture. It has even been suggested that they were the first Europeans to be acquainted with Indian languages.[5]

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[2] (Teltscher 1995, 2).

[3] (Jami 1995; Raina 1999; Teltscher 1995, 2; Inden 1990; Županov 1999; Županov 2005).

[4] (Kejariwal 1988, 14)

[5] Ibid, 15

The canonised studies of Schwab and Biès have elaborated upon the French interest in India in the eighteenth century.[6] The travelogues of the French traveller, François Bernier who arrived in 1656 made a deep impression in the century of its publication and on the social sciences in the subsequent centuries.[7] Furthermore, given Bernier's proximity to Gassendi, it is unlikely that the acolyte Jesuits leaving Lorient for Pondicherry in the last decades of the eighteenth century were unaware of Bernier's work. One must not forget the important amount of Akbar's court provided by the Jesuit Pierre du Jarric [Du Jarric, 1926]. Consequently, the letters of the French Jesuits in India are framed partially by an available portraiture of India that had been developed by French travellers in the first half of the seventeenth century. However, there were other equally influential frames that had emerged within the Jesuit seminaries themselves, which we shall come to later in the essay.

For most of the second half of the seventeenth century the geographical expanse of the Indian subcontinent was seen by the French as politically divided in two: the Moghul India of the North that was more or less independent from "l'Inde pathane" and "l'Inde carnatic".[8] The literature appearing at this time on India in the form of reports addressed the struggle for power on the subcontinent and offered an analysis of the same.[9] By 1706 the Compagnie des Indes Orientales had all but disappeared, and was reconstituted in 1719. However, the connection between the interests of the Compagnie and cartography must not be precluded. The versatile French Jesuit missionary Jean Venant Bouchet, S.J. (1655–1732), who arrived in Pondicherry in 1689 and died there in 1732 compiled a map of South India. The map was used by G. Delisle and formed the basis for the accurate map of the Indies prepared by the French cartographer J.B.B.d'Anville in 1752. The map depicted peninsular India in great detail, where both the missionaries and the Compagnie had a presence.[10]

The French missionaries who came to India in the late seventeenth century were the first to have spoken of India's scientific past. French Indology, according to Filliozat, emerged in the early decades of the eighteenth century, when the King's librarian requested Etienne Fourmont, of the College Royal, to draw up a list of works of note from India and Indo-China, to be purchased for the King's library. By 1739, a catalogue of Sanskrit works had been prepared, and copies of Vedas, epics, philosophical and linguistic texts and dictionaries had been procured.[11] The first volume of this catalogue entitled "Catalogue des manuscripts de la bibliothèque du roi" was published in Latin and contained a listing of most of the books shipped. Curiously enough there were very few, if any, so called

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[6] (Biès 1974; Schwab 1984)

[7] (Teltscher 1995, 29)

[8] (Duarte 1932, 195)

[9] (Pouchepadass 1991, 54)

[10] (Edney1997, 5)

[11] (Filliozat 1951, 1–3)

scientific texts that were included in the cargo to the king's library.[12] There is cause to speculate as to what lies behind this mystery. This generation of French missionaries in India were possibly preoccupied with studying the philosophy, and the "niveau de connaissances scientifiques" of the Indians.[13] The Jesuit astronomers studied the Indian astronomical systems that Filliozat considers "the first scientific or even cultural achievements of India studied by Europeans".[14] Kejariwal goes so far to suggest that the "history of French Orientalism is also the history of the rediscovery of ancient Indian astronomy in the modern period".[15] But this rediscovery was not enabled through a systematic collection of classical Sanskrit and Tamil texts on the subject but through conversations between Jesuits and the interlocutors they considered knowledgeable in the astronomy practiced in the South Asian region. As I have argued elsewhere this account was a proto-ethnographic one.[16] And while these Jesuits met Indian astronomers at the court of Jai-Singh, the influential ethnographic reports produced from Pondicherry and Chandernagore were based on their encounters with the makers of *panchānga* or calendars prepared for ritual purposes.[17]

Outside the sphere of the Jesuit scientists in China and India, two French academies exhibited an interest in India. These were the Académie des Sciences and the Académie des Inscriptions et Belles Lettres. The former's interest in India was restricted to that domain of knowledge that would serve the purposes of navigation, commerce, the transfer of particular techniques notably in the areas of textiles and pharmacopoeia, and diplomacy as and when France found the need to engage in military operations.[18] In the last decades of the seventeenth century the French Jesuits were expelled from Siam during the course of a political uprising. In fact, in the year 1687 the French ambassador to Siam, M. de la Loubère returned to Paris and incidentally presented Louis XIV a Sanskrit astronomical manuscript from Siam. This manuscript contained rules for the computation of the longitudes of the Sun and the Moon and served as one of the sources for the histories of Indian astronomy authored by the French astronomers Le Gentil and Bailly (Raina 2003). However, in the seventeenth century Gian-Dominique Cassini, then heading the Paris observatory translated the computational rules contained therein into the language of modern astronomy (Sen 1985, 49).[19]

[12] (Raina 1999)

[13] (Filliozat 1954)

[14] (Filliozat 1957)

[15] (Kejariwal 1988, 17)

[16] (Raina 2003).

[17] (Sharma 1982).

[18] (Murr 1983, 242).

[19] Three chapters of the second volume of the text entitled *Description du royaume de Siam par M. de la Loubère* (Description 1714] deal with astronomy. Pages 113–149 deal with Siamese astronomical rules for calculating the motion of the sun and moon; decoded by Cassini, who suggests that these rules clearly suggested an Indian influence. The second chapter, a long

These computations agreed with the value obtained in the *Paulisa Siddhanta* of Varahamihira (c.505 –c.558 CE), it was much later argued that these computational rules were derived from the latter text (Sen, 1985, 50).

The first reports of the Jesuit expeditions from India and China reached Paris in 1692, but had been sent to Paris by 1688.[20] The *Observations* is a document in two volumes, the first consists of 113 pages and contains scientific reports of observations made by the Jesuit astronomers stationed in India, China and South East Asia. Of interest here are the reports of Père Richaud from Siam and subsequently Pondicherry, fixing the latitudes and longitudes of towns and drawing up a map of the Indian peninsula.[21] The entire volume is prefaced by Cassini, wherein he dwells on the collaborative relationship between the Jesuit order and the Académie.[22] But more importantly Cassini outlines the objectives of the project. Pointing out the expeditions that had been dispatched to various parts of the globe, he suggests that a comparison of the several observations would enable the construction of "...Geographie universelle aussi exacte qu'elle peut l'estre".[23] These sets of activities in India and China suggest that the Jesuits were pursuing a large astronomical project at the request of the Académie, which involved not just observations but interactions with local astronomical traditions.[24] It has been pointed out that around this time astronomers worked with data that were obtained from a wide variety of sources across the globe. As Schaffer writes:

> Long-range systems of accumulation of facts and commodities were decisive aspects of the early modern information order. Adapting prestigious accounts of colonial voyage and conquest under the aegis of the Catholic Monarchy, enterprises ... linked distant travel and advances in knowledge. Joint-stock trading corporations and the vast missionary enterprises of the Society of Jesus, for example, set up networks of trade, storage and communication through which new kinds of knowledge and performance were developed...Though Newton's relations with Jesuit natural philosophers and historians were notoriously and traumatically fraught, these priests would provide recalcitrant but indispensable resources for his own endeavours.[25]

The focus of our attention here is the French Jesuits who arrived in India towards the end of the seventeenth and the early decades of the eighteenth centuries. In all between the years 1608 and 1770, there appear to have been

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one – pp. 1150–234 -, is a reflection on the Indian computation rules; and is based on material obtained on Père Tachard́s voyage to Siam. Siam in the 1680s was at the intersection of two astronomical traditions, Chinese and Indian, and the Jesuits picked up both at that location.

[20] (Observations 1692).

[21] (Observations 1692, 17–20).

[22] "Messieurs de l'Academie Royale des sciences, ayant agrée les premiers observations faites aux Indes par les Jesuites François, que j'eus l'honneur de leur presenter de la part de ces Peres en 1688... Depuis ce temps – là mesmes Jesuites François ont continué à observer sur les instructions de l'Academie," (Observations 1692].

[23] (Observations 1692).

[24] (Hsia 1999).

[25] (Schaffer 2009, 245).

about sixty Jesuits of French and Italian origin stationed on the Indian subcontinent, of which about forty resided at the various Jesuit missions in India between 1700 and 1770.[26] Off the sixty stationed on the Indian subcontinent about ten were engaged in astronomical and other scientific activity. During this period commencing in the last quarter of the seventeenth century the focus was on the acquisition of South Asian texts, the study of South Asian languages and the translation of these texts.[27] Jesuit missionaries in the eighteenth century collected works of classical learning in the form of manuscripts from the sub-continent and sent them to France.[28] Evidently, there were differences in the way different Christian missionaries of diverse orders looked at India and its knowledge systems. Often enough national rivalries within Europe played themselves out within the same order. In fact, the Jesuits were distinguished from other Catholic missions in India such as the Dominicans, the Augustinians, and the Capuchins by the liturgical practice of accommodation to Hindu customs.[29] The Jesuits thus fashioned themselves in the mould of *sanyasis*, savants and modelled their lives to be strictly as pure as that of the *sanyasis* they encountered.[30] Furthermore, they undertook the study of Sanskrit texts in order to participate in religious debate.[31] This practically became a sort of liturgical necessity with the Jesuits that more or less accounted for their familiarity with Sanskrit scholarship and their commitment to the world of Sanskrit learning.

As indicated above the Jesuit collections of Indian manuscripts in France did not include a substantial number of scientific texts – in fact that collection is miniscule. Nevertheless, the Jesuit ethnographic writing does contain ample discussion on the sciences of India and here it is important to reverse the gaze from India to Europe, and in this post-colonial reversal we look upon this ethnographic material produced by the Jesuits as historical material about the history of Indian mathematics and astronomy. In other words the collection of manuscripts and the preparation of ethnographic material could be studied within the same frame of collecting knowledge about the Orient. And if that be a legitimate exercise, we need not ask only what manuscripts were collected but examine Jesuit narratology and their social technologies of writing.[32]

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[26] (Launay 1898).

[27] (Lafont 2000, 23).

[28] (Lafont 2000, 24).

[29] (Teltscher 1995, 74).

[30] (Murr 1983, 236).

[31] (Teltscher 1995, 74–5).

[32] (Shapin and Schaffer 1985).

The Narratology of the Jesuit *Lettres* and Reports

Between the years 1700 and 1750 Europe viewed India primarily through the medium of the letters of the French Jesuits.[33] The letters of the French Jesuits stationed throughout the world were collated and published between 1702 and 1776; the volumes appeared every second year between 1706 and 1743.[34] The letters were grouped together, scattered over several volumes and are considered important for their ethnographic merit in providing a pre-colonial account of India. Where did this ethnographic style come from? What were the precedents of Jesuit ways of explicating the world?

Historically oriented anthropologists have approached the Jesuit missionaries in India quite diversely. In a recent work Županov has employed the term cultural cartography to map the encounter of the Jesuit missionaries with their local converts and interlocutors.[35] In her study of the *Missionary Tropics* Županov suggests that the "tropics" connotes a geographical space referring to India and the Indian Ocean, and that metaphorically alludes to the set of texts about India which "bring home to Europe a sense, sensibility, and knowledge of what lies out there".[36] The underlying premise of the discussion that follows is that the scientific component of the Jesuit writing cannot be easily separated from the religious. And even if they could be separated the narrative form did not vary appreciably. In other words, Jesuit writing on Indian astronomy and Indian astronomical practices were structured by the very literary technologies that framed their ecclesiastical discourse, and in the *Lettres* the two were fused together within the same text.

Secondly, this discussion on the Jesuit narratology is premised on the assumption that the narratology did not alter appreciably between the founding of the Madurai mission by Roberto de Nobili (1577–1656) in the first half of the seventeenth century and the time of the French Jesuit astronomers, Jean Venant Bouchet, Stanislas Boudier, Xavier Duchamp and Coerdoux stationed at Pondicherry in the fist half of the eighteenth century. What did change was the mode of engagement and writing, from de Nobili's deep engagement and mobilization of textual material from the Sanskrit legal tradition to the ethnographic first person accounts of the French Jesuits.

A century earlier Bacon had described cosmography as "a kind of history manifoldly mixed". This involved recounting the natural history of regions, the historic and civil account of habitations, the manners of people, and discussions of mathematics in terms of the climates and the ordering of the heavens. These cosmographic observations were to be blended with personal narrative.[37]

[33] I use the term narratology squarely in the sense of the theory of narrative and narrative structures as defined by Todorov (Todorov 1969, 9).

[34] (Teltscher 1995, 4).

[35] (Županov 2005, 2).

[36] (Županov 2005, 1).

[37] (Teltscher 1995, 14–15).

Cosmography provides a frame for comprehending the letters and reports of the French Jesuit astronomers in India in the eighteenth century. The letters themselves were clearly of a propagandistic nature, and were published to raise funds for the order, and the demands both for funding and legitimacy increased as pressure mounted against the Jesuit order in Europe during the second half of the eighteenth century.[38] Thus the *Lettres* served as publicity material to attract funds for the Society.[39] Furthermore, the narrative was also responding to the expectations and addictions of the reading public back in France. This meant that the readership's expectations included "digressions and amplifications containing descriptions of foreign lands and peoples, peppered with eye-witness exaggerations, pious pathos and heroic adventures".[40]

As we move from the early to the middle decades of the eighteenth century the building criticism against the Jesuit order in France redirects the narratology of the letters such that it neutralizes the criticism of the detractors and wins public support. The self-justificatory tropes included the representation of their endeavours abroad as successful, their members as virtuous, and untainted by idolatrous practices.[41] Unlike in the travel writing of say Bernier, where the reader is occasionally greeted by a double hermeneutic that simultaneously undermines the sense of both Indian and European exceptionalism, the Jesuit letters were not marked by self-contradiction, but by the very opposite tropes of certainty and consistency.[42]

This preoccupation with the form of Jesuit ethnography needs to be clarified. For while the first Sanskrit texts on Indian astronomy were identified and translated by the British Indologists, it is not my intention here to explore the process of collection of these texts. Rather it is to suggest that the British Indological project relating to Indian astronomy was inspired by the histories of Indian astronomy authored by the French astronomers Le Gentil and Bailly. These histories in turn inherited the historiography of the Jesuits through the ethnographic reports of the Jesuits on the astronomical knowledge of the Indians they encountered. Since these ethnographic reports are not original Sanskrit manuscripts they are not less important material for historians of science for they document the astronomical practices of Indian astronomers or calendar makers to be more precise. The essay then is about the elevation of these ethnographic reports to the status of historical manuscripts on which the first histories of Indian astronomy were based. The British Indologists are mentioned in so far as we wish to direct attention to the subsequent genealogy of the history of Indian astronomy in the eighteenth and nineteenth centuries.

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[38] (Murr 1983; Teltscher 1995, 4).

[39] (Murr 1983, 239).

[40] (Županov 1999, 6).

[41] (Teltscher 1995, 75; Clooney 2005, 3–5).

[42] (Teltscher 1995, 75).

This brings us to the epistolatory form of Jesuit writing. Ignatius Loyola, the founder of the order had prescribed subjects for Jesuit writing, especially for those stationed outside Europe. There were to be four components of Jesuit written composition and correspondence cast in a specified narrative form. The first were accounts of kings and nobles, and these were to be recorded as dramatic, theatrical vignettes. The second was to deal with the life, habits and customs of the common people, and these virtually took the form of ethnographic descriptions. Naturally there were disputes within the order and it was prescribed that these disputes be couched in dialogical or polemical terms. And finally, their own individual ambitions were sublimated in the rhetoric of sainthood and utopianism.[43] Furthermore, on the more specific issue of writing letters Loyola had suggested that letters consist of two parts: the first dedicated to the edification of the readers; and then these were to be rewritten such that the content was systematically structured.[44]

In such a tightly cast, and evidently doctored form it is surprising how much of Jesuit writing was subject to free loading and plagiarism (an anachronistic term for the times). The advantage of location and engagement with local populations conferred on their descriptions of the new and old worlds a concrete authority that made them vulnerable to rampant literary piracy. In the case of the French Jesuit Coerdoux stationed at Pondichery this was doubly so. The first time at the hands of Abbé Dubois[45] and the second time around, but less perniciously at the hands of French astronomer Le Gentil. But the Jesuit encounter with India as with other cultures and regions of the world strained their mental repertoire; despite which two strands of mental engagement ensured a robustness. These included on the one hand the natural faculties of reasoning, and personal experience, and on the other a healthy empiricism: As Županov reminds us: "The other, the foreign, the strange was seen as a "factum" to be surveyed, enumerated, described, explained, catalogued. The data thus produced and collected ... remain a witness of various experiments in the methods of conversion, persuasion, surveillance and social engineering".[46]

The problem of reconciling the other separated by the dichotomies of us and them, interior and exterior, one and many was a source of both frustration and creativity and crystallised in ways of addressing other cultures and ways of knowing, namely the universalist and the ethnic. Todorov, in his study of the conquest of America suggests that the relation to the other and the problematic of alterity is never constituted in just one dimension. Rather it is locatable along at least three orthogonal axes: axiological – involving value judgements about equality and inferiority, one involving a rapprochement – involving an identification or submission to the other, epistemic – ignorance of the other's identity,

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[43] (Županov 1999, 7).
[44] (Županov 1999, 9–10).
[45] (Murr 1987).
[46] (Županov 1999, 22).

invoking a gradation between "lower or higher states of knowledge".[47] The Jesuit desire to image the other as oneself worked itself out in a universalism in Latin America that all but annihilated Amerindian practices and cultures. In regions where pagan civilizations were seen to be far more "resilient", the Jesuits went native.[48] The geo-ethnographic mode of writing was as pointed out earlier at the threshold of scientific discourse – and developed from the eighteenth century onwards to produce Orientalist disciplines by affecting transformations in the narratology at three levels: moving from landscapes to descriptions; from events to stories and human subjects to ethno-graphic data. This mode was not monolithic and contained a simultaneous desire to describe and interpret.[49]

As part of the Jesuit practices of accommodation in India and China, the French Jesuits working at the Madurai and Pondicherry missions lived the ascetic and austere lives of the Indian *sanyasis*. The exemplar was set for them a century earlier by de Nobili and Bouchet had taken on the indigenous renunciant name Periya Sanjivinatha (Revered master of spiritual healing).[50] A recent biography of the life of Bouchet, easily the most important Jesuit astronomer with Boudier, is based on a reconstruction of nine letters published in the *Lettres* between 1700 and 1720s or thereabouts, whose length varied between 4 and 76 pages. The biographer Francis Clooney, interestingly reads the letters along three axes: (1) Observations about India, (2) Dramatizing the mission and the missionary, (3) Theologizing India and Europe.[51] Evidently, the narrative template first provided by Ignatius Loyola and later developed in India by de Nobili continued to serve the goals of the mission in the first half of the eighteenth century.

This narratology offers a structure for reading the correspondence and reports of the French Jesuit astronomer and cartographer Claude Stanislas Boudier (1687–1757). Boudier's reputation as an astronomer earned him an invitation to Jai Singh's court in 1734. During his journey to and sojourn at Jaipur, like his counterparts in China, Boudier determined the longitude of sixty three Indian cities, in addition to measuring the meridional altitudes of a few stars.[52] In addition, he observed the first satellite of Jupiter on 2 April, 1734 at Fatehpur, and again at Jaipur on 15 August of the same year. He also observed the solar eclipse of 3 May 1734 at Delhi and had earlier reported the lunar eclipse of 1 December, 1732. It appears that just as the French Jesuits provided the last accurate figures of the longitudes of the leading Chinese cities, Boudier did the same for Delhi and Agra.[53] Furthermore, there is an extensive

[47] (Todorov 1984, 185).
[48] (Županov 1999, 24).
[49] (Županov 1999, 103).
[50] (Clooney 2005, 3).
[51] (Clooney 2005, 9–11).
[52] (Ansari 1985, 372).
[53] (Ansari 1985, 372).

correspondence between Delisle and Boudier from 1730 to 1760 that I shall discuss in a forthcoming paper. This correspondence essentially details Delisle's requests for a number of astronomical observations to be performed and the Jesuit responses to these requests. This correspondence could help in pinning down the local interlocutors, if any, with whom the Jesuits had established a relationship of trust.[54] But before proceeding to a discussion on a Jesuit manuscript, it could be argued that the years 1730–1735 comprised the high tide of French Jesuit astronomical activity in India.

The Duchamp Manuscripts

Two early Jesuits manuscripts whose career in historical scholarship is evident were sent by Père Patouillet and Père Xavier Duchamp. Two of the three important sources appearing in Jean-Sylvain Bailly's *Traité de l'astronomie indienne et Orientale*[55] were based on so called Sanskrit manuscripts. One of them was sent by Père Patouillet from India to the astronomer Joseph de Lisle in 1750. This was a copy of the *Pancānga Siromani*. As the title of the work suggests, this was clearly an almanac. The manuscript may have come from Masoulipatnam or Narsapur, but Bailly felt that it came from Benaras that has the same meridian as Narasimhapur, whose provenance was questionable.[56]

There are two manuscripts ascribed to Duchamp. One of these is referred to as the "Xavier manuscript", [57] is in fact an ethnographic treatise on Hindu astronomy authored by Duchamp, which he had mailed to Gaubil at Beijing.[58] The manuscript is referred to here as (Duchamp 1750) and is extant at the Observatoire de Paris. There is another manuscript extant at the Archives françaises de la Compagnie de Jésus at Vanves, Paris.[59] However, both these manuscripts are not Sanskrit manuscripts at all but comprise accounts of Indian astronomical practices, calculations of eclipses based on the explication of the procedure followed by Tamil astronomers at Pondicherry, and contain a glossary of astronomical terms employed in Sanskrit and Tamil. As will be elaborated below, these ethnographic accounts were not obtained through contact with astronomers familiar with the *Siddhāntas* but were products of exchanges with calendar makers who worked with astronomical manuals. Thus

[54] (Rinckenbach 1998).
[55] (Bailly 1787).
[56] (Sen 1985, 50).
[57] (Sen 1985).
[58] (Sharma 1982, 348).
[59] (Duchamp 1734). In an earlier paper I had assumed that the two manuscripts were the same as the Xavier manuscript (Raina 2003). This is evidently not so, though much of the astronomical material contained in (Duchamp 1734) is not too radically different from that in (Duchamp 1750), Yet the astronomical practices are documented in more detail (Duchamp 1734) even though (Duchamp 1750) is a larger manuscript.

the interlocutors of the Jesuits were possibly not the leading astronomers of the region. Both Patouillet's manuscript and the Duchamp manuscripts were the focus of much discussion with the astronomers Bailly, Laplace and Delambre that we shall discuss later.

Père Duchamp's manuscripts suggest that within the Indian astronomical tradition there existed many methods for identifying the meridian, calculating the equations of the sun, moon and the planets. A perusal of the first of these manuscripts[60] suggests that at the time the manuscript was prepared Père Duchamp had not deciphered the steps in the operation employed to calculate the time for the commencement and the duration of eclipses. The procedures he documents have to do with those operations that were employed to calculate past eclipses. To validate his reconstruction of the computations of the Brahmins, Duchamp requested the help of a Brahmin astronomer ("panchanganiste" – a calendar maker), and used his method as an exemplar in order to illustrate the method employed.[61] During this proto-ethnographic phase of French Indology, [62] the *Surya Siddhanta* began to be canonized as the Indian *Almagest*. It is very likely that Duchamp was unable to decipher the Siddhāntic rules for calculating eclipses, and during his interviews with the calendar makers he encountered learned of the *Surya Siddhanta* as the source of the computational algorithm.

But let us say a little more about the manuscript refered to as (Duchamp 1750) that elaborates upon some of the points made above and discloses several others.[63] Thus Duchamp begins by pointing out that there is a method called the "Souriasiddantam", though it is not clear at this juncture whether he knew of the work by the same name, or whether the method is to be found in a work that goes by that name:

> Il faut avouer qu'il y a une methode nommée Souriasiddantam qui sert a ce qui paroist de regle, *mais cette regle a été entendue autre fois , car aujourd'huy personne ne l'entend, qu'oy que tous les calculateurs Indiens*, disent qu'ils calculent sur le Souriasiddantum mais l'ors qu'on leur fait remarquer des fautes dans leur calcul, alors ils repliquent que cela n'ariveroit pas, *si on entendois bien le Souriasiddantum … je ne crois pas que les sçavans parviennent au bout de le dechiffrer*; mais le Souriasiddantum luy méme n'est pas sont faute, et le contour que cette method donne a la terre est prodigieux on aura peut etre lieu de le marquee.[64] (emphasis mine)

[60] (Duchamp 1734).

[61] (Duchamp 1734, folio 000002).

[62] It would be anachronistic to refer to this phase of the encounter as ethnography, and I shall mean proto-ethnographic when I write ethnographic. Because even when the encounter was "proto-etic", the reconstruction of the "other" knowledge systems still bore the signature of either Christianity, or modern astronomy.

[63] While quoting from (Duchamp 1750), I shall be adhering to the French spelling and accents as encountered in the original manuscript.

[64] (Duchamp 1750, 1).

In an earlier paper (Raina 2003) it was pointed out that the French Jesuits had invented two tropes, *the tropes of disfigurement and forgetting*, to accommodate non-European peoples into a Christian chronology – another version of Todorov's problematic of alterity. The enlightenment historians of astronomy, Le Gentil and Bailly transformed them into tropes wherein the Indians had forgotten the rational of the astronomical methods employed by them, and that they had disfigured the methods acquired from an ancient people. On examining the Duchamp manuscript I find the need to correct this apercu, and suggest that the secular version of these tropes of the history of science prefigure in the Jesuit accounts. Clearly both these tropes are fairly explicit in the passage above, and they are encountered repeatedly in the text. Thus a couple of lines later Duchamp remarks:

> Qu'oy que les sçavans Indiens de ce tems ne scachent que la mechanique de leur Calcul, il est difficile de les fait parler: ils ont plus d'un interest dans ce silence si la crainte en general que par la ils ne perdent une resource pour vivre en vendant leur almanacs, ou si l'on veut leur connoissance de tem, a ceux des brames qui courent leur village, pour anoncer les nouveaux mois, les bons et mauvais jours.[65]

The passage further reveals the anxiety produced by the lack of comprehension. This incomprehension is then transferred by Duchamp to the interlocutors, who were not astronomers but producers of almanacs, whom Duchamp later refers to by their local professional name. If the trope of forgetting is evident here, the other trope follows closely, in that Duchamp indicates that the method that was communicated to France through the French ambassador M. de la Loubère was totally in ruins or disfigured: "sans doute que le sçavans ne communiqué qu'une methode toute delabrée".[66] Following these general remarks Duchamp proceeds to specify his methods of investigation and outline the domain of his study:

> On a donné les operations comme on les a aprises et comprises et la signification des mots qu'on a comprise, pour les autres on en a pu, encore tirer aucune notion des scavans du pays.[67]

While acknowledging the small number of missionaries stationed in India and their larger religious commitments Duchamp indicates that there is a lot more they would like to do in the field to satisfy Louis le Grand and more importantly to gratify their colleagues – "sçavans de france". In so doing Duchamp simultaneously cautions his readers from romanticizing the world of learning in India, and the authority of his words and observations derive from the fact of his being stationed in India:

> Quand je nomme sçavans Indiens, il ne faut pas s'imaginer que cette science soit fort vaste, communement les Brames sont les seuls qui scachent lire, et de ceux cy un

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[65] (Duchamp 1750, 1).

[66] (Duchamp 1750, 1).

[67] (Duchamp 1750, 1).

> nombre borne la science a sçavoir calculer, peu a avoir lû les livres ou sont des principles de raisonnement, et un certain nombre tres rare a calculer les eclipses. Quelques uns de la plus haute caste des Brames lisent et apprennent par coeur les vedams, mais il ne les entendent pas, un nombre parmy eux a peine sçavent ils lire.[68]

We have here a representation of the literate class on the subcontinent, rather small and restricted to the Brahmin caste, and amongst them were an even smaller number who would understand the principles and the reasoning behind specialised technical texts and even fewer who would know how to calculate eclipses. The Jesuits in any case played an important role in insinuating the idea that the Brahmins were the authentic interlocutors for the civilization. Furthermore, an essential feature of the Jesuit astronomical project was to compare the predictions of eclipses obtained by the methods practiced on the sub-continent with the actual onset of the eclipses and determining the deviation of the prediction from the actual onset. Thus the manuscript discusses the eclipses of the 4th of July and 8th of July 1731 as exemplars, [69] and the deviation from the predicted values. This tells us something about when the Duchamp manuscript was written, which is in and around 1734, the time of the preparation of the other Duchamp manuscript.[70] The comparison between the computed and observed values of the eclipses led the Jesuits to comprehend the theories and measurement of time as practiced on the subcontinent. In any case, they had been preoccupied with Indian chronologies. They reckoned that the Indian year consisted of 12 months and was founded on the lunar calendar with an additional month being intercalated periodically. Duchamp shows an awareness of the cycle of 60 calendar year names (*kilika* being one of them), and the names of the lunar months (e.g. *bhadrapadam*). Thus 1725 was an intercalary year, from here the discussion proceeded to the naming of the months and the seasons and the units of time such as the *ghadias*. Clearly Duchamp had picked up these theories and measures from a local astrologer. This is based on his reference to the Hindu calendrical days referred to as the paṅchānga. This five-fold division is comprised of tithi (lunar day), vāra (weekday), naksatra (asterism), yoga (sum of the lunar and solar longitudes) and karaṇa (half-lunar day). He identified two of these as "iogam, and karanam".[71]

The point that Duchamp's entry into the world of Indian astronomy was not through the texts of Siddhantic astronomy but through the makers of paṅchānga is evident by his own admission:

> J'ay vu un almanach fondé sur des strophes, où après avoir raisonné sur ces matières et donné des principes généraux, on parcourt chaque année de siécle Indien, et on prédit l'abondance ou la stérélité ce peut être ce qui se fait avec la plus d'apareil, et ce qui est le plus cru [. . .] Là vient *le Brame panchanganiste* et il annonce tout a ce qui regarde de l'année qu'on commence. Entre les Dieux et les planettes, qui son general d'armée et

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[68] (Duchamp 1750, 1).
[69] (Duchamp 1750, 1).
[70] (Duchamp 1734).
[71] (Duchamp 1750, 2).

> suivant les sloka des le meme se houiera Roy, minister general, on dit quell est le Dieu des grains, de ris, dub le d'Inde [. . .].[72] (emphasis added)

Expediency characterised the relationship between the Jesuits and the "panchanganiste'. For the Jesuits the latter provided the key into the world of religious practices, which in any case was their primary preoccupation. This is something Duchamp alerts us to in the first lines of his manuscript. A detailed discussion of the Duchamp manuscript awaits another paper. Nevertheless, the Duchamp manuscript indicates that the Jesuit interlocutors were not astronomers; secondly, by their own admission the task of translation was marked by a degree of incomprehension; a feature that the French astronomer Le Gentil was to exploit.[73] But this inability to decipher the text was resolved through the evocation of the trope of forgetting that would go into the construction of the antiquity of Indian astronomy and mathematics by European mathematicians and astronomers. Thus Duchamp would indicate that:

> J'ay tiray du secours d'un petit cahiers du R. Père Bouchet, il est surprenant que le Père restast en si beau chemin, il a eu une bonne méthode mais à present délabrée par la vieillesse, il est n'avoit pas peû déchiffrés.[74]

The mystery here is that Duchamp never attempted to acquire a copy of the *Surya Siddhanta* or any of the Sanskrit astronomical Siddhantas and through his native informers attributed the source of the methods he carefully transcribed to this subsequently canonized text. In fact, there is a great deal of tentativeness about his conclusions that derives from his misgivings concerning the textual source of the method. This textual inadequacy Duchamp transfers to the secretiveness of his Brahmin interlocutors. But he had succeeded in insinuating the idea that this text was the Indian Almagest and less than half a century later the British Indologists would not only find it but provide us with the first translation in English.[75] The first French translation would have to wait for another 50 years.[76] But more importantly, for the Jesuits this textual vacuum would have its positive side for it centred Duchamp as the appropriate authority to interpret this text; this was a strategy that Nobili had mastered in the Jesuit discourse on India. This Jesuit privilege of first hand knowledge that validated their claims back home in Europe is effectively deployed by Bouchet as well: "I have in fact been aware of the opinions of the Brahmins. I have read many books by wise Indians, and I have often engaged their more able teachers: from reading the former and engagement with the latter... I have drawn all that detailed information

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[72] (Duchamp 1750, 2).
[73] (Raina 1999).
[74] (Duchamp 1750, 4).
[75] (Davis 1790).
[76] (Guerin 1847).

which can aid me in probing deeply their system regarding the transmigration of souls".[77] We shall reflect upon this claim in the last section.

The Jesuit J.-F Pons arrived in India in 1726 and after spending a few years in Thanjavur was appointed Superior of the French Mission in Bengal. Other than compiling a Sanskrit grammar, and a treatise on Sanskrit poetics that was sent to Europe, he visited Delhi and Jaipur with Père Boudier, mentioned earlier, to make some astronomical observations.[78] We find an account of this in a note entitled "Observations: Geographic expedition undertaken in 1734 by Jesuit Fathers during their voyage from Chandernagor to Delhi to Jaipur" in the *Lettres Édifiantes*.[79] In fact, this is a report on the very observations mentioned earlier. The report begins by pointing out that the Raja of Amber, Sawai Jai Singh, a savant in astronomy, for whom the Jesuits had undertaken this expedition, had a number of astronomers working for him.[80] Jai Singh had requested the Superior General of the church at Chandernagore, Boudier, to send Jesuit fathers stationed at Chandernagore to make some observations; and so Pères Pons and Boudier set out for Delhi and Jaipur.

The Collection of Manuscripts

By the end of the seventeenth century and the first quarter of the eighteenth century there was a compelling demand for a view of India through Indian texts. There was now a desire to access more direct sources of information – a new obsession for original texts in various languages and for their accurate translation had taken root.[81] Thus we can see a new stage in the scholarly encounter with India. Indian manuscripts that had reached Europe prior to this period were Persian manuscripts that had travelled from Constantinople. From the 1620s onwards a search for Indian and Persian manuscripts seems to have been systematically pursued. The quest for Indian manuscripts was initiated by Abbé Jean-Paul Bignon in 1727 and Etienne Fourmont furnished a memoir that inventoried a list of specific works in Sanskrit and Persian that were to be acquired. There was also a growing interest in the Académie des sciences in India (Murr 1983).

Preparatory activity preceded the finalisation of the list, involving attempts to systematically classify the material that had been collected from India and China. This task was undertaken by Hebrelot de Molinville whose *Bibliotheque Orientale* was published in 1697.[82] Bignon's and Fourmont's requests included works on Indian chronology, dynastic histories and the religions and customs of India. All three concerns fell squarely under the Jesuit project in India, and possibly

[77] (Bouchet quoted in Clooney 2005, 54).
[78] (Bamboat 1933, 95).
[79] (Lettres 1810, 15: 269–291).
[80] (Lettres 1810, 15: 269).
[81] (Lafont 2000, 34).
[82] (Lafont 2000, 33–35).

elsewhere. As far as India was concerned, the French Jesuits were the only ones capable of executing such a programme. Consequently, Bignon and Fourmont corresponded with the governor general of Pondicherry Lenoir to work out a scheme for the collection of manuscripts with the Jesuits. By which time the Jesuits had already completed the preparation of Tamil and Sanskrit dictionaries.

An agreement was signed between the Jesuit Le Gac and Lenoir, the governor general of Pondicherry. According to the terms of the agreement necessary funding was to be provided by the Compagnie des Indes and this expenditure would be reimbursed by the King of France. The agreement included the preparation of two copies of each Sanskrit work, one was to be despatched to the Royal Library in Paris and the other was to be maintained at the Jesuit mission at Pondicherry. A person was appointed to distribute the paper to a Brahmin who supervised its distribution in the villages where the required texts were copied; his additional responsibility included monitoring the transcriptions and collection.[83] Between 1729 and 1735, 287 volumes reached Paris and constituted the Bibliothèque Nationale's earliest Indian collection. In 1732, the Jesuit scholar Pons shipped 168 books from Chandernagor to Paris: this included 31 books on philology (which was largely his preoccupation and certainly a Jesuit specialty), 22 mythical and philosophical poems, 25 puranas, 8 books on astronomy and astrology, 9 books on poetry, 25 books on laws customs and worship of the gods, 29 books on nyaya darsanam[84] and 9 on the other darsanam.[85]

Off the 31 works on philology, several were works on Sanskrit grammar, commentaries on Sanskrit grammar and dictionaries, in addition a Tamil and Telugu dictionary from the region of Mysore was acquired; further the collection included a Telugu-French dictionary, a Telugu-Sanskrit dictionary, and 2 Tamil dictionaries from Pondicherry.[86] These works are mentioned in several catalogues none of which appear to be complete. The first of these catalogues was prepared by the Jesuits Pons and Le Gac shortly after the books were sent to Paris; a second one was prepared by Hamilton and Langlès in 1807; a fourth one by Cabaton in 1907–1912, and finally even the Catalogue du fonds sanskrit of Filliozat is also incomplete.[87]

But from the works mentioned in the catalogues we could safely infer that the collections included the great literary works of India extending from the epics to the productions of the early medieval period. By 1736, several copies of the Vedas and the Indian epics existed in Paris. A synthesis of these studies and efforts of the Jesuits was prepared by Pons himself and published in part XXVI

[83] (Lafont 2000, 35).

[84] In Indian philosophy, e.g. the Nyaya or school of logic or Vedanta are considered as the different darsanas or schools of philosophy.

[85] (Lafont 2000, 36).

[86] (Lafont 2000, 92).

[87] (Lafont 2000, 93).

of the LEC in 1743.[88] However, Pons was deeply fascinated by Indian philosophy and logic and the despatches numbered 122–168 were on philosophy; that included the darsanas, the *Kusumanjali* and *Kiranavali* of Udayana and Vardhamana's commentaries on these works. These were probably versions of the text extant in Bengal, since they were mailed from Chandernagore; in addition to these were a collection of works attributed by Pons to "Le Maitre" and these included the texts of Raghunatha Shiromani and Godadara Bhattacharya. The despatches numbered 80–87 in Omont's catalogue of Missions Archéologiques refer to works on astronomy and astrology.[89] The Table 1 below lists these works:

Table 1 Listes des manuscrits envoyés de l'Inde par les Jésuites. (1729–1735) pp. 1179–92; p. 1181

80. Siddhianta-Manzari[90]
81.Zatak-arnava
82. Bhassuati[91]
83. Jiôti-pradipa,[92]
84. Suddhi-dipika
85. Krama-dipica
86. Samaï-pradipa
87. Sat-kritia-dipica

But there are two features that surprise us about these works on astronomy and astrology. The first is that they never appeared to have a career in French Indology; to my mind it appears as if these volumes just disappeared into the shelves of the library and surfaced merely in catalogues from time to time. The second equally surprising feature is that the Jesuits who had carefully documented Indian astronomical and mathematical practices strayed across so few astronomical and mathematical texts. This appears to me rather mysterious and for which I have no adequate explanation. One could only conjecture, based on the astronomical reports of the Jesuits and their reckoning with the special conditions of textual circulation in India. The one plausible explanation we could offer is that they considered their documentation of existing astronomical and mathematical practices as a veritable substitute for the classical Sanskrit and Tamil manuscripts. I have discussed the impact of this assumption elsewhere.[93] And while they observed and underlined the importance of the

[88] (Lafont 2000, 36).

[89] (Omont 1902, 1179–92)

[90] This is a treatise on elementary astronomy authored by Mathurānātha Vidyālankāra published around 1609 A.D (Sen 1966, 143).

[91] The Siddhāntas were texts on computational astronomy, the karaṇas were simple manuals containing rules for carrying out computations. The Bhāsvatı was such a karaṇa authored by Śatananda, and its date is ascribed to be 1099 A.D. (Sen 1966, 193).

[92] All we know about this text is that the Jyotipradıpa is an astronomical work authored by Rāma Sarman (Sen 1966, 183).

[93] (Raina 2003).

Surya-Siddhanta they did not procure a copy of it, and no French translation of the work is encountered till the third decades of the nineteenth century. The most likely explanation is that at Pondicherry and Madurai their circle of interlocutors did not include a single Indian scholar familiar with the textual traditions of Indian astronomy, and the image of Indian astronomy that they invented arose out of their modality of engaging with almanac makers. This is a fairly strong statement, but we will come to its plausibility ahead.

John Playfair's Programme and Colebroke's Recovery of Indian Algebraic Texts

As far as the subsequent history of Indian astronomy and mathematics is concerned the French Jesuits of the seventeenth and eighteenth century were the inaugurators of a tradition, which was to inspire the histories of Le Gentil and Jean-Sylvain Bailly.[94] Bailly's history inspired the work of the British mathematician John Playfair and provided a stimulus to subsequent generations of British Indologists writing on Indian mathematics; though they were to disagree with the details of Bailly's *Histoire*, adding some nuance here and digressing from it in another context. The antediluvian hypothesis proposed by Bailly was the source of both fascination and controversy, and was the outcome of his attempt to juxtapose observations of ancient Indian astronomy with astronomical theory of his day; from which he went on to draw the inference that ancient Indian astronomy was the source of Greek astronomy (Bailly 1775). However, this reading was located within Jesuit historiography that sought to accommodate Indian history within the Christian conception of history (Raina 2003).

Bailly's work was introduced to English speaking readers through an article authored by the mathematician and geologist John Playfair (1748–1819), entitled "Remarks on the Astronomy of the Brahmins" published in the *Transactions of the Royal Society of Edinburgh* in 1789.[95] The article draws extensively, need I say almost exclusively, upon the *Mémoires* of Le Gentil[96] published by the Académie des Sciences, Paris and Bailly's *Astronomie Indienne*.[97] This article of Playfair's was of prime importance for Indologists working on the history of Indian astronomy for the next four decades, despite the fact that it was inspired by the work of such "un vulgurisateur".

Just in and around the time Bailly's *Traité* appeared, the important tradition of British Indology was beginning to crystallise. Marsden and Bentley were the first to contest Bailly's assumptions and calculations. This opened the

[94] (Raina 1999).
[95] (Playfair 1790).
[96] (Le Gentil 1785).
[97] (Bailly 1787).

floodgates of criticism in France. Playfair jumped into the controversy attacking Bailly's critics for their amateurism and for daring to question Bailly's superior abilities. One of the early papers of the legendary William Jones was dedicated to defending Bailly's thesis concerning the origins of the Hindu zodiac. Playfair's central contribution resided in re-appropriating Bailly's Traité in the light of the contributions of Samuel Davis and Burrow and proposing a set of tasks that could well be considered a research programme for the Asiatic Society. These included: (a) to search for and publish works on Hindu geometry (b) to procure any books on arithmetic and going by Burrow's article on the binomial theorem amongst the Indians to ascertain those arithmetical concerns whose trace is not to be found among the Greeks, (c) to complete the translation of the *Surya Siddhanta* as initiated by Samuel Davis, (d) to compile a catalogue raisonné, with a scholarly account of books on Indian astronomy, (e) to examine the heavens with a Hindu astronomer in order to determine their stars and constellations, (f) to obtain descriptions and drawings of astronomical buildings and instruments found in India.[98]

Bailly had stirred a hornet's nest in his time by suggesting that the origins of astronomy were in India, albeit this astronomy was inherited by the Indians from an even more ancient people. Burrow's paper did the same with the origins of algebra. It is at this time difficult to separate the discussion on the history of astronomy from the history of algebra; for both the Académiciens and the Indologists often turn to the history of astronomy to evoke computational procedures that were analyzed mathematically. This programme of the recovery of the mathematical literature from the astronomical literature was taken up by Colebrooke, who may be seen as providing translations from the Sanskrit into English of the first texts supposedly dedicated solely to algebra and arithmetic. I say supposedly because portions of some of the texts Colebrooke's discovers for the English-speaking world were essentially the mathematical sections of larger astronomical canons of the Indian tradition.

Colebrooke's translations certainly mark a departure in the study of the history of Indian mathematics. Stated briefly two main historiographic currents in the eighteenth century oriented the study of the history of the mathematics and astronomy of India. The first approach was that pursued by the Jesuit savants in India, who were observing the astronomical and computational procedures circulating among Indian astronomers and that has been discussed in the previous pages. British administrator-scholars, who studied texts, collated fragments of texts, and published translations with critical editions and commentaries, while indebted to the first, pursued another approach. In the late eighteenth century, Sanskrit commentaries and canonized astronomical or mathematical works were considered the key to obscure technical terms and texts. Whether these Sanskrit texts shared the same destiny as some of the Vedic texts requires a separate examination. For it has been pointed out that by the

[98] (Playfair 1792, 152–5).

second half of the nineteenth century some Sanskritists belittled, marginalized and removed "explicit references to the intermediary process of transmission and exegesis of texts without which they would not have had access to them".[99]

Both Colebroke and Davis worked with commentaries of canonized astronomical and mathematical texts. Inspired, as it were, by the textual exemplars of Davis and Burrow, and guided by the research programme John Playfair had drawn up for the researchers of the Asiatic Society, Colebrooke highlighted the pathway to his own work:

> In the history of mathematical science, it has long been a question to whom the invention of algebraic analysis is due, among what people, in what region was it devised, by whom was it cultivated and promoted, or by whose labours was it reduced *to form and system* [100] (emphasis added).

With the appearance of Colebrooke's translations, the terrain of historical studies on Indian mathematics was transformed into a polemical one, since his characterization of the tradition ran contrary to the portrait of the French scholars. In other words he attempted to push the characterization of Indian mathematics in directions other than those defined by the binary typologies of the history of mathematics. The lack of mathematical authority amongst the network of the British Indologists served as major handicap and deterred his ability to create a new vocabulary. This also explains why John Playfair was so important to the Indological enterprise. He was a mathematician of repute who conferred the Indological accounts with authority.

A Word on the Jesuit Mystery and a Contemporary Dispute

The Jesuit reports and manuscript collections gathered between 1730 and 1765 shaped the invention of the history of Indian astronomy and mathematics, at a moment when the key constructs of the ancient civilizations of Chaldea, Egypt, Greece, China and Persia begin to appear within historical discourse, given the then current preoccupation with questions of historical chronology, racial origins, and the urgent Jesuit task of reconciling biblical chronology with Indian history.[101] Jesuit scholarship shaped the enlightenment construction of

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[99] (Vidal 1997, 25).

[100] (Colebroke 1817, 121).

[101] (Raina 2003). Bouchet's correspondence with Pierre-Daniel Huet the author of *Demonstratio Evangelica* (driven by the certainty of putting religion on geometrical lines) seeks to aid the latter with confirmatory evidence from a fresh venue – India. In this letter he traces sources of India's wisdom to the Bible, thereby validating Huet's thesis "that all the religions of the world could be derived from the truths, revealed to the people of Israel in the Bible" Thus Bouchet's scholarship is driven in support of a settled hypotheses (Clooney 2005, 46–7). He writes: "...I have given to you an account of the detailed information I have gathered among the people of India, who were apparently in other times Christian and then for a long time plunged back into the shadows of idolatry" (Bouchet, quoted in translation by Clooney 2005, 52).

the history of Indian astronomy and mathematics that appeared in the last three decades of the eighteenth century. This it did by providing the central tropes for assimilating the origins of astronomy in India within the incipient encyclopaedic discourses on the history of astronomy that were being produced.

The formal end of Jesuit Indology and the beginnings of secular Indology coincide with the ban on the Jesuit order, though the Académie des Sciences had revealed their desire to produce secular histories at least three decades earlier. By the second half of the eighteenth century with the suppression of the Jesuits, the Académie des Sciences' interest in India from the anthropological point of view was more accentuated, and it attempted to produce a positive discourse on the people of India.[102] But the collections of Indian manuscripts and the reports on Indian astronomy to be encountered in France by the end of the eighteenth century was a fruit largely of Jesuit activity based on scientific expeditions and projects undertaken in the first half of the eighteenth century.

However, radical developments in contemporary Jesuit historiography have generated new sets of questions and revised our ways of approaching old ones. This enables us to get back to the mystery concerning the absence of Jesuit textual collections of scientific manuscripts. Hitherto, most Jesuit historiography has been either "polemical or edifying" and oftentimes "unabashedly partisan". The new frames began to change in the twentieth century when Jesuit historians produced a scholarship in three historiographical formats. The first involved the publication of hundreds of volumes of edited documents produced by the Jesuit missions throughout the world. This was accompanied by the publication of meticulously written national histories. Finally, monographs on Jesuit institutions and personalities began to be published.[103] Further, changes within the Jesuit order particularly within Latin America and India prompted major rethinking of the Jesuit project, the history of the missions and important Jesuit scholars.[104]

Thus Clooney's biography of Bouchet is emblematic of this trend and reflects the criss-crossing of several historiographic developments. In the earlier Jesuit historiography, there was a tendency to portray important Jesuit scholars as the founders of "Orientalism" or "Indology". Immediately after the founding of British Orientalism/ Indology several claims began to be made on behalf of the French and Italian Jesuits in India.[105] The claims were made on their behalf for a variety of reasons and varied with time. Jean-Baptiste Biot in the early part of

[102] (Murr 1983, 243).

[103] (Županov 2005, 2).

[104] See the essays appearing in the volume edited by Amaladas entitled *Jesuit Presence in Indian History* (Amaladas 1988).

[105] In the preface to a recently published work we read: "Certains Occidentaux, pourtant s'intéressaient aux langues et aux cultures de l'Inde, pour des raisons évidentes: les missionaires, dont beaucoup furent d'excellents linguistes. *On peut dire qu'ils ont été les premiers "orientalistes". Mais c'est un fonctionnaire anglais, juge à Calcutta, William Jones, qui donna aux études orientales la qualité scientifique nécessaire*" (Renouard 2000, 234) (emphasis added).

the nineteenth century would fervently argue that the French Jesuit in India Pons was the true founder of Indology.[106] Similar claims were made in the twentieth century on behalf of the Italian Jesuit de Nobili and later Bouchet.[107] Within the Jesuit order in India and outside, a revised perspective has emerged in the last quarter of the twentieth century that has critically re-evaluated the Jesuit project in India.

The history of the Jesuit order in India was based, amongst other works, on the eighteenth century accounts of the Jesuits themselves that said little about their engagement with their local interlocutors or who or what they were. A central question posed today in the context of Bouchet and his colleagues was whether they really comprehended and appreciated the "Hindu intellectual traditions" of their time? The second question raised is whether the local interlocutors or "conversation partners" of the Jesuits were the best that could have dialogued and debated with them? [108] In other words, were they the leading Sanskrit or Tamil scholars of the time? These questions undermine some of the authenticity of the eighteenth century Jesuit accounts, for they are prompted by a critical examination of Indian sources that reveal the absence of any evidence that the Indian scholars took any of the French Jesuits in Pondicherry seriously.[109] The natural question then is: who did the Jesuits speak to? As far as Bouchet is concerned, Clooney suggests that the former was in "conversation with articulate Hindus who could speak for the tradition as locally practiced, but not with learned teachers who had mastered the textual tradition".[110] In the discussion on the Duchamp manuscript it was obvious that Duchamp had reconstructed Indian astronomical practices through his conversation with the almanac makers and not those embedded in the tradition of Siddhāntic astronomy. Further, the burden of unintelligibility of the procedures was transferred to the tradition that was seen as crumbling. The technical questions for which he received no response from the almanac makers were then interpreted in terms of the deficit in the tradition or of a "forgetting". This "forgetting" was to resurface in the "history of Indian astronomy and mathematics" and was to be propagated in accounts of nineteenth and twentieth centuries.

From our own perspective there might have been a virtue in the reconstruction of the tradition in terms of ethnography of everyday practices. However, during a period when a new historical discourse on the antiquity of the sciences was emerging, the Jesuit account facilitated the construction of the Indian astronomical tradition as procedural, performative and pragmatic. And it is here that the Jesuit practices from the seventeenth century radically differ from

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[106] (Raina 2000).
[107] (Clooney 2005).
[108] (Clooney 2005, 65).
[109] (Clooney 2005, 65).
[110] (Clooney 2005, 66).

the eighteenth century. The transition, from the high textual tradition in which later French Indology would be grounded, to one of the proto-ethnography of astronomy was significant in creating the standard representation of Indian mathematics and astronomy. It could also be said then that the reading practices of the Jesuit astronomers and their narratology of dialogue with other traditions gave form to their scientific collections.

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Scientific Texts in Contest, 1600–1800

Chu Pingyi

Introduction

In recent decades, the role of canonical texts in major literary civilizations has been a subject of much debate. Some regard canonical texts as the essence of a civilization. Others stress the selected nature of these texts, arguing that the formation of authoritative texts is a power process which serves the interests of the elite who controls these texts. This debate warns historians to scrutinize how essential texts of a civilization are chosen and how they impinge on our historical understanding of that civilization.

In the Chinese case, the status and authority of Confucian classics (*jing* 經) were often taken for granted as the crystallization of Chinese culture. The high status of Confucian classics invited imitations from practitioners in other fields of knowledge. The making of classics was not always successful and did not guarantee the transmission of texts supposed to be authoritative. Practitioners, nonetheless, named their important texts *jing* in order to assert the significance of the texts and the knowledge they contained.

Classics are not only important but sometimes also even sacred to the extent that questioning these texts is equivalent to doubting the tradition. To the members of the tradition of knowledge associated with such texts, the virtues of the contents justify the *raison d'être* of their existence as if they were natural concomitants of the human world. Classics thus receive more attention than other texts; conversely, texts which attract attention come to be considered classics. This cycle of mutual enhancement between recognition and canonical texts renders the formation of classics seemingly natural, as if the light of truth was contained within the classics themselves.

The short description above should have signaled the man-made character of classics and the power implications of making a text canonical. Exactly because of their importance, classics impose what Pierre Bourdieu would term "symbolic

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F. Bretelle-Establet (ed.), *Looking at It from Asia: The Processes that Shaped the Sources of History of Science*, Boston Studies in the Philosophy of Science 265,
DOI 10.1007/978-90-481-3676-6_5,

violence" on practitioners in a certain field and influence how later historians understand the trajectory of that field.[1] Not only do they orientate the way of thinking and guide the practices of those who read and propagate them, but they also mystify the power of those who have mastered these texts, excluding other texts as less important or inferior. Therefore producing and setting up classics are political matters, as serious in late imperial China as were the cases of defining what texts qualified as Confucian classics in the past Chinese dynasties. The compilation of several astronomical and mathematical classics in seventeenth and eighteenth-century China can also be situated in this vein.

This paper examines the making of scientific classical texts and their significance in the seventeenth and eighteenth centuries. Instead of focusing on an analysis of the contents of these texts, I address the process of making classics to shed light on this general phenomenon. I am particularly interested in the historical visions constructed in these texts, for they not only narrate the origin, as if the *logos* was innate to the knowledge itself, but also impact on how later generations would envision the history of this knowledge. This exercise will historicize the classics and politicize the writing of history as well. While not taking classics and their history for granted, an examination of the formation of the canon provides an opportunity to turn to texts neglected and develop other possibilities of writing the history of science.

The Rhetoric of Syncretism

When the Jesuits came to China to spread the gospel, they soon discovered that they had first to repair the Chinese calendar. Not long before they arrived in China, the Ming calendar had lost its precision and the court astronomers, who were unable to fix the problems, had become the laughing stock of Beijing for their incompetence.[2] To reform the Ming calendar, the Jesuits and their associates launched a translation project to introduce European astronomy and mathematics in 1629. Their efforts crystallized in the *Chongzhen lishu* 崇禎曆書 (Calendrical Treatises of the Chongzhen Reign) which many later Chinese astronomers and mathematicians would mine to improve their scientific skill.[3] It was the most important astronomical and mathematical classic in seventeenth-century China.

It is well known that when Paul Xu (Xu Guangqi 徐光啟 1562–1633), one of the most important patrons of Christianity in the seventeenth century, commenced on this great enterprise of translating Western astronomy and mathematics for the Ming calendrical reform, he had in mind that Western and Chinese science would be integrated in the future.[4] However, the rhetorical

1 (Bourdieu and Passeron 1977, 1–68).

2 (Chu 1999a 490–493).

3 (Chu 2007).

4 (Engelfriet and Siu 2001).

aspects of his assertions have largely gone unnoticed. In his famous memorial presented to the Chongzhen emperor in 1630, Xu detailed not only the necessary expenses to meet the demands of constructing new astronomical instruments and of the daily routine to run the newly established astronomical section for the purpose of calendrical reform, but also the usefulness of Western science for statecraft. Also proposed was to distance astronomy from the previous astronomical model used in the Ming court where Muslim and *Datong* 大統 (Grand Unity) calendars were both kept without much cross-fertilizing. Xu argued in this memorial that to transcend the *Grand Unity* calendar, translation was essential. The sparse documentation of the *Grand Unity* calendar called for new input from the Western methods which included comprehensive documentation and new information on astronomical observations collected around the world. After completing the translation, it would be possible, Xu claimed, to integrate the Western materials into the model of the *Datong* calendar.[5] Thus many modern scholars praise Xu as an enlightened intellectual who cherished his own tradition while appreciating the significance of foreign knowledge.

We have to pay special attention to the context of Xu Guangqi's statements in order to comprehend his rhetorical strategy. The Ming had employed a dual calendrical system since the establishment of the dynasty. The Chongzhen emperor simply treated the Western calendar as a supplement to others which would serve his needs. Xu, nonetheless, denied the efficacy of such a parallel model and proposed an integration of Chinese and Western systems which would then transcend both systems. Xu asserted that Western calendrical methods could be applied at least to the next two or three hundred years without flaw, and that they would generate useful information for later astronomers to revise the calendar, if changes were necessary. Moreover, they would also enable later astronomers to understand the art of calendar making and make it possible to transcend the current calendar. Once this had been accomplished, Xu then suggested that whoever understood the true meaning of the *Grand Unity* methods be recruited to attend to the matter of calendar making so as to produce an integrated calendar. Xu metaphorically described this process as constructing a building in which not only would the outlook of the architecture remain as grandiose as it used to be, but the delicate bricks and balks of the mansion would last forever.[6]

What Xu had actually proposed to the throne was less an integration of scientific knowledge than a reorganization of the bureaucracy. Following his suggestions, the Ming calendar would only preserve its name since the contents and technical details would be replaced by European astronomy. In this vein, it is not surprising that Xu Guangqi downplayed the significance of the Chinese astronomical tradition, rendering the newly translated texts a new beginning of Chinese astronomy.

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[5] (Xu 1983, 788:10–11. Han 2001).

[6] (Xu 1983, 788: 10. Chu 1999a).

Xu Guangqi savaged the Chinese astronomical tradition on several fronts. He doubted whether Guo Shuojing 郭守敬 (1231–1316), the greatest astronomer before his time, really comprehended the Principle (*li* 理) of calendrical making since the way of calendrical making had not begun until Matteo Ricci arrived in China.[7] Xu pointed out that Guo did not even know that the earth was spherical, the fundamental assumption of calendar making. Xu even insinuated that Guo was so jealous as to suppress the ideas transmitted from Muslim astronomy.[8] In addition, Xu ridiculed some of the astronomical passages, which had assumed that the earth was flat, in the *Zhoubi* 周髀 (The Gnomon of the Zhou) as the stupidest paragraphs in the history of astronomy and mathematics.[9] Xu also complained that *Jiu Zhang* 九章 (Nine Chapters of Mathematical Procedures), another mathematical classic, although it had discussed the methods of trigonometry, was unable to exhaust its significance. Whereas the mathematical contents of dealing with trigonometrical questions were similar in both Western and Chinese traditions, the examples in the *Nine Chapters of Mathematical Procedures* were messy and therefore not applicable.[10]

Xu Guangqi also complained about the paucity of Chinese mathematical texts that one could mine. Xu and his Christian friend Li Zhizao 李之藻 (1565–1630) had surveyed Chinese mathematics while working on the translation of Western mathematics. They found that most Ming mathematical works were simple and often filled with errors, while ancient mathematical works were sparse. Even when ancient mathematical works could be found, they often contained only procedures but lacked sufficient explanations. Xu was certainly aware of the similarities between the two traditions and was ready to appreciate the merits of Chinese mathematics. Unlike astronomers in the Qing, however, Xu saw these similarities simply as proof of the universal validity of mathematics. Even under these circumstances, Xu claimed that the Chinese methods were no match for their Western counterparts since they could not explicate the meaning of certain procedures (*fayi* 法義 or 法意). If discrepancies were found, Xu asserted, it was the Chinese methods which violated mathematical principles. By contrast, the translation project that Xu currently embarked on would generate new theories and information for interested parties to work with. In the end, Xu concluded, even if the *Ten Mathematical Classics* of the Tang reappeared, one could discard them.[11]

Since, in his view, the Western methods were superior and comprehensive, Xu was skeptical about the need of integrating the two systems. His synthetic

7 (Xu 1983, 73).

8 (Ibid, 63).

9 (Ibid, 84).

10 (Ibid, 85).

11 (Xu 1986, 79–81). Xu's attitude toward Western science is not exceptional. His contemporary Xiong Mingyu 熊明遇, who was an official interested in Western natural philosophy, also examined Chinese natural knowledge critically and asserted that part of it was simply wrong or untrustworthy. (Xiong 1993.)

narrative was thus a camouflage to advance the Christian interests in both science and religion with cautious diplomatic rhetoric. This analysis should have made clear that cross-cultural scientific transactions are not mere exchanges of knowledge. To practice or implement scientific knowledge involves adjustment of human and non-human agents such as the institutions and instruments. That Xu Guangqi and the Jesuits vested the calendrical reform with extra religious purpose further intensified the conflict between them and other involved social groups such as other astronomers in the Astronomical Bureau and literati who believed in other religions. Xu's religious and political commitments as a Christian Confucian statesman largely restricted Xu from proposing a dual system of the calendar. The rhetoric of integration thus aimed at advocating the monopoly of European astronomy through which the true belief of God could be introduced into China.

The History of the Calendar

After a long bitter struggle within the Astronomical Bureau and several astronomical observations to test the precision of the calendar, the result finally turned in Xu's favor. In 1643, the Chongzhen emperor proclaimed the adoption of the new calendar revised by the Jesuits and their Chinese associates.[12]

Adam Schall von Bell (1592–1666) continued Xu Guangqi's denigrating attitude toward indigenous tradition and expressed his contempt even more clearly after the Qing had overthrown the Ming in 1644. Although Schall took charge of the Astronomical Bureau, the Qing ruler retained its original structure. Schall remained facing his old enemies. To tighten his control over the Bureau, he recompiled *Calendrical Treatises of the Chongzhen Reign* and bestowed on it a new title to emphasize the supremacy of the Western calendar: *Xiyang xinfa lishu* 西洋新法曆書 (Calendrical Treatises in Accordance with the New Methods). In this new collectanea published in 1646, Schall appended four treatises of his, in which he gave up Xu Guangqi's rhetorical disguise and stressed the superiority of the calendar he had created.

These four treatises functioned as introductions to the whole collectanea. Schall detailed the astronomical adjustments that the Jesuits had made in order to fit into the form of the Chinese calendar and the exclusion of astrological elements in his *Xinli xiaohuo* 新曆曉或 (Enlightening the Bewildered about the New Calendar).[13] He briefly introduced the Western methods in his *Xinfa liyin* 新法曆引 (An Introduction to the New Methods) within which he stressed the prowess of his new astronomical instruments, calculation tools and trigonometrical tables. However, in this treatise he also depicted Chinese calendars as a stagnant tradition trapped in an unchanged model with minor technical

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[12] (Zhang 1976, 543).

[13] (Gugong bowuyuan 2000, 1:124–30).

improvements. He criticized both Guo Shoujing and Muslim astronomers, blaming them for forcing celestial phenomena into their models. Schall then emphasized that the new methods he had created were transmitted from a persistent tradition in the West. The Western calendars had prevailed against the tests of astronomical observations and Schall further added new data that he had collected during his travels to China. Unlike the artificial character of the Chinese calendar, Schall cropped his methods to match celestial phenomena.

Schall further challenged Chinese astronomy in *Xinfa biaoyi* 新法表異 (Explicating the Differences of the New Methods). He first contrasted the calendar he made with other calendars in Chinese history so as to prove its precision. Like Xu Guangqi, Schall criticized the patchwork nature of Chinese calendars, ridiculed Guo Shuojing, who had never heard the system of epicycles, and invited the readers to judge the depth of Guo's learning.[14] Schall then proceeded to describe the essentials of spherical astronomy and he did not forget to underscore the power of his calculation tools and astronomical instruments. Through a comparison between Chinese and Western astronomy, Schall demonstrated that these differences in theory, practice and material culture had given Western methods a leading edge.

In the *Lifa xizhuan* 曆法西傳 (The Western Legacy of Calendrical Methods), Schall concocted a history for Western astronomy which had become more comprehensive and precise as time progressed. Schall portrayed himself as an heir of European astronomy from Ptolemy to Tycho Brahe (1546–1601) in order to prove that the new methods were not his own invention in recent times but a continuous effort accumulated through thousands of years. This plea for tradition would not only ward off criticisms but also encouraged students to concentrate their minds on learning so that they would perform necessary revisions of the calendar in the future. He then advanced to the relationship between Chinese and Western astronomies. He pointed out the similarities found in Western and Chinese astronomy. Similarities that once proved to Xu Guangqi the universal validity of science were now proofs of a genealogical relation between the two traditions, with the Western one as the ancestor. According to Schall, Chinese astronomy was simply an inferior version of Western astronomy, mimicking it but lacking its efficacy. Schall further argued that celestial phenomena revealed themselves to all; therefore, no one could produce a calendar simply based upon one's personal opinion. Since the Chinese had now all learned Western methods and the Chinese calendar had been rooted in Western methods, reconciling the differences was not a problem as long as people read his astronomical collectanea. Just as the Chinese had to be converted to Christianity to redeem their sins, so Chinese astronomy had to be transformed into Western astronomy in order to reconcile the differences between the two systems.[15]

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[14] (Ibid, 1:309).

[15] (Ibid, 1:256, 274–75).

In these four new treatises that Schall appended to the *Calendrical Treatises in Accordance with the New Methods*, he blatantly revealed his contempt for the Chinese calendrical tradition. Both Xu Guangqi and Adam Schall had turned historical materials of Chinese astronomy and mathematics into a leverage with which they shook the Chinese scientific tradition and demonstrated the advantages of European science. Their profound belief in the advanced nature of Western science also largely relied on the arsenal of accumulated texts and data they had translated. Nevertheless, Xu approached his construction of the history of Chinese astronomy and mathematics with caution probably because of the 1616 Nanjing persecution.[16] Schall's circumstances were different. Although his calendar was soon legitimated as a symbol of the Qing's dynastic mandate, his competitors remained at the Astronomical Bureau. He had to persuade the Qing rulers of the power of European astronomy and mathematics so as to monopolize the calendar and make the Jesuit mission secure. Constructing a hierarchical order between European and Chinese science via a narrative of origin was part of his strategy.

Through the narrations in these four treatises, Western astronomy would acquire its significance with a long, persistent history attached to it. In 1656, Schall put together the *Explicating the Differences of the New Methods*, *An Introduction to the New Methods* and *The Western Legacy of Calendrical Methods* and published them in two bound volumes. Moreover, he presented them to the Shunzhi emperor who agreed to place this selection in the Imperial Historical Archive (Shiguan 史館). Schall used them as an avenue to lead the emperor to the new Western astronomical methods crafted by the Jesuits and to assure the legitimacy of his calendar.[17] The calendar was directly associated with the mandate of the empire in Chinese history, however, and Schall would thus soon encounter backfire not only from astronomers in the Astronomical Bureau but also from literati who engaged in astronomical research. Although the Western calendar survived the attack of Yang Guanxian during the early Kangxi reign (1664–1669), the cultural war over the calendar was yet to begin.[18]

A Revolutionary Rediscovery: Dai Zhen and the *Siku quanshu* Project

Information related to European astronomy and mathematics spread rapidly since the late Ming. For instance, Wang Yingming 王英明, who probably was the first Chinese scholar to compose a book on Western astronomy, recompiled Western astronomy in a simplified manner to help his son prepare for classical studies.[19] Gu Yanwu 顧炎武 (1613–1682) ascribed the geometric account of

[16] (Dudink 2001).

[17] (Schall and Verbiest n.d., *juan* 3, 23a–27a).

[18] (Chu 1997a).

[19] (Wang 1983, 789:947).

eclipses uniquely to the Christian associates who had gained access to Western sources.[20] Wen Deyi 文德翼, who wrote a preface for Jie Xuan's 揭暄 *Xuanji yishu* 璇璣遺述 (Bequeathed Legacy of Astronomy), witnessed that many literati were learning Western astronomy in Fujian and Zhejiang.[21] Wang Xichan 王錫闡 (1628–1682) commented that the *Calendrical Treatises of the Chongzhen Reign* was very popular and had become the new classic for astronomers.[22] Wu Hong 吳宏, a legal secretary (*shiye* 師爺) who lived in Shaanxi 陝西 province in the early Qing, once wrote to one of his kinsmen, a Chinese Christian serving at the Astronomical Bureau, to request a replica of a world map which Wu had once hung on his wall but which had been destroyed by a monkey. In addition, he also asked for a copy of Verbiest's *Yixiangzhi* 儀象志 (Monograph of Astronomical Instruments). Wu made it clear that if his kinsman was so eager to spread Christian teachings, he would also generously share these scientific objects to advance his Christian cause.[23] These pieces of evidence as well as literati who wrote prefaces for books on Western natural philosophy and astronomy, or even anti-Christian literati who found these works offensive, indicate that scientific Jesuit works had reached a broad base of readers over the course of the seventeenth century. Moreover, Western science was closely associated with Christianity in Chinese readers' minds.

Facing the surge of new and abundant astronomical and mathematical knowledge published by the Jesuits, Chinese literati interested in natural studies fought their battles on three fronts. First, they commenced on an ideological reconstruction of the history of astronomy and mathematics to overturn Schall's claim that these branches of knowledge had a Western origin. Mei Wending 梅文鼎 (1633–1721) championed this ideological reconstruction of history, and his version of the "Chinese origins of the Western learning" remained influential throughout the dynasty.[24] Secondly, they initiated a search for lost wisdom so as to construct a textual tradition to meet the challenge of the books that the Jesuits had published. Thirdly, they had to purge the religious implications contained in Western science so that they would not damage the legitimacy of the dynasty while utilizing Western scientific knowledge for their own research and statecraft. They did not accomplish the last two goals until the *Siku quanshu* 四庫全書 (Complete Library of the Four Treasuries) project took shape in 1773.[25]

The *Complete Library of the Four Treasuries* project started a large scale search empire-wide of available texts and also made efforts to recover books

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[20] (Gu 1984, 856).

[21] (Wen 1899, *juan* of prefaces, 4b).

[22] (Wang 1983, 93:453)

[23] (Wu 1999, 258).

[24] (Chu 2003; Chu 2005).

[25] (Guy 1987; Chu 2007). The impact of this gigantic compilation on the historiography of Chinese science is also discussed in this volume by Bréard, Chemla and Bretelle-Establet.

from the *Yongle dadian* 永樂大典 (*Grand* Compendium *of the Yongle Emperor*). The search for lost texts impacted not only on literary culture in general but also on astronomy and mathematics. Dai Zhen, who was responsible for recomposing the fragments of mathematical texts from the *Grand Compendium of the Yongle Emperor*, was celebrated as a cultural hero of the day by his contemporaries.[26]

The astronomical and mathematical section of the *Complete Library of the Four Treasuries* lists eleven texts restored or collated from the *Grand Compendium of the Yongle Emperor*. Since a large portion of the *Grand Compendium of the Yongle Emperor* has been lost, it is now impossible to know which books were included and how Dai proceeded in his restoration. From the catalogue of the *Grand Compendium of the Yongle Emperor*, we know that the mathematical texts that Dai Zhen recovered were mainly under the character *suan* 算, totaling 35 *juan*. In addition to the five *juan* of basic operations and eight *juan* of miscellaneous categories, the remaining twenty-two *juan* contained all the contents of the *Jiuzhang*, except the part on *fangcheng* 方程 (systems of simultaneous linear equations).[27] The first *juan* under the character *suan* included a list of mathematical books in the past and their contents, which must have been very helpful when Dai Zhen restored these classics.

Judging from the current surviving three *juan* of the *suan* part of the *Grand Compendium of the Yongle Emperor*, (Table 1) Dai Zhen was very selective in his choice. He seems to have had in mind the idea of the Tang "*Ten Mathematical Classics"* used to test the official astronomers since the texts that he endeavored to recover were all composed before the Song. In 1777, the year Dai passed away, the texts he had restored or collated were presented to the Qianlong emperor who had them published in the *Wuyingdian juzhenban congshu* 武英殿聚珍板叢書 (The Essential Collections from the Wuying Hall), (Table 2) a selection of the most precious books in the *Complete Library of the Four Treasuries* using wooden moveable type. According to Duan Yucai 段玉裁 (1735–1815), who had composed Dai's *nianpu* 年譜 (chronology), Dai had written the analytical catalogues (*tiyao* 提要) for these texts.[28]

In addition to reviving the textual tradition of the most ancient mathematics, Dai Zhen also reassembled two other texts from the *Grand Compendium of the Yongle Emperor* for their symbolic value. Both Qin Jiushao's 秦九韶 (1201–1261) *Shuxue Jiuzhang* 數學九章 and Li Ye's 李冶 (1192–1279) *Yigu yanduan* 益古演段 (New Steps in Computation) discussed the heavenly element (*tianyuan* 天元) method —in Li Ye's book, an equivalent to the algebra the missionaries transmitted for establishing higher degree equations in one unknown.[29] Though Qin's book still survived during the Ming, Ming

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[26] (Ruan 1982, 542).

[27] (Yao 1848, 44:*juan* 42, 18b–20a).

[28] (Duan 1980, 487–491).

[29] Qin's work is often referred as *Shushu Jiuzhang* 數書九章.

mathematicians did not understand it. Xu Guangqi and Matteo Ricci had acknowledged its existence, but the *Calendrical Treatises of the Chongzhen Reign* did not discuss the heavenly element method. It seems that compilers of the *Complete Library of the Four Treasuries* attempted to imply that even if Xu and Ricci had known the text, they too would not have comprehended it. Li Ye's *Yigu yanduan*, which used illustrations to illuminate difficult mathematical problems, including the heavenly element method, had been lost during the Ming.[30] Since both texts focused on algebraic problems, the compilers of the *Complete Library of the Four Treasuries* thus intended not only to construct a textual tradition parallel to the European calendrical studies but also to surpass them by reviving the method that the Jesuits and their associates had not understood. (Table 3–6) After Qin's and Li's texts were restored, discussions of algebra became an important research field for the Chinese mathematicians of the nineteenth century.

In contrast to Xu Guangqi, a Christian promoter of Western science who would jettison the *Ten Mathematical Classics* without regret, it is small wonder that Dai Zhen, who had been able to restore these lost treasures to which Xu did not even gain complete access, received such a high reputation among evidential scholars. It is certainly not only because Dai's scholarship fit into the main current of evidential research, but also because his textual endeavors equipped Chinese astronomers with a new textual arsenal comparable to the texts that the Jesuits and their Chinese associates had created, providing thereby a solid foundation for the ideological claim of the "Chinese origin of Western learning." Dai Zhen himself was aware of his own contributions and proudly claimed that the eminent *chouren* (mathematicians and astronomers) of the early Qing like Wang Xichan and Mei Wending had never even read the *Ten Mathematical Classics*.[31] Making comments without even reading a text was certainly a severe mistake that those who espoused Western methods had committed. The compilers of the *Chourenzhuan* 疇人傳 (*Biographies of Mathematicians and Astronomers*), which constructed a genealogy of Chinese mathematicians and astronomers from ancient times to the Qing, would later comment that those people who did not read ancient texts and preposterously judged that the Western methods were superior to the Chinese ones simply knew the Western methods but not the ancient Chinese ones.[32] In the cultural war against the European astronomy, Dai Zhen had won the most important battle in the eyes of his contemporaries. The Chinese methods contained in mathematical classics, once deemed inferior by the Jesuits and their associates, were now turned into the ancient methods, as a long lost tradition recovered with its mathematical structures and methods retained in classics, thereby regaining its value. Judging from modern mathematics, we may see that some of the methods in these

[30] (Yong 1983, 3:312).

[31] (Dai 1980, 148).

[32] (Ruan 1982, 568).

restored classics were not as powerful as the Western ones. Nonetheless, this cultural battle was mainly an ideological one, and it did not matter which methods were really inferior. The compilers of the *Complete Library of the Four Treasuries* and *Biographies of Mathematicians and Astronomers* simply attempted to make a holistic claim that the Chinese methods contained in the classics had never been inferior to their Western counterparts.

Assimilating European Mathematical Astronomy

The revival of the indigenous mathematical and astronomical tradition soon diluted the significance of Western knowledge. The *Analytical Catalogue of the Complete Library of the Four Treasuries* revealed this change of balance between Chinese and Western science clearly.[33] Its strong anti-Christian sentiment is well-known to modern scholars. Though the anti-Christian pitch was high, the Confucian literati responsible for the *Complete Library of the Four Treasuries* project were not xenophobic conservatives hostile to anything foreign. In their eyes, Christianity had declined to the status of an illegal heterodoxy since the Yongzheng 雍正 emperor forbade it in 1724. The Jesuits and their Chinese associates, however, continued to occupy positions in the Astronomical Bureau because the calendar they made had won the emperors' endorsement. Being unable to challenge their legitimacy in calendar making, the Confucian literati endeavored to recover their own scientific textual tradition to re-network interested Chinese scholars. They reoriented the significance of the Western astronomy by writing the analytical catalogue appended to each astronomical and mathematical work in the *Complete Library of the Four Treasuries*. Their general strategy was to reconfigure the field of astronomy and mathematics around the Manchu emperors. The Kangxi emperor, the sagely emperor who had compiled great astronomical and mathematical collectaneas, was thus turned into an emblematic figure, from whom stars and numbers acquired their significance.

Although Dai Zhen's rediscovery of ancient texts had made the reorientation of the significance of European science possible, he should not be credited as the sole author of the analytical catalogue of the astronomical and mathematical sections.[34] Such an intellectual effort of bestowing cultural meaning on natural knowledge was rather a collective enterprise. Guo Bogong 郭伯恭 has convincingly demonstrated that the *Analytical Catalogues* underwent a continuing editing process and that the chief editor Ji Yun 紀昀 (1724–1805) was probably responsible for the final product.[35] Certain lower ranking officials drafted an

[33] *The Analytical Catalogue of the Comprehensive Collection of the Four Treasuries* will be referred as *the Analytical Catalogues* hereafter.

[34] (Qian 1983b).

[35] (Guo 1992, 209–225).

analytical catalogue for a book while some other higher ranking officials would check and edit the draft. The final product is often very different from the original one. Therefore, the opinion presented in the *Analytical Catalogues* has to be seen as a collective opinion.

Before the first copy of the *Complete Library of the Four Treasuries* was completed, two other selections of the collectanea had been compiled. Jin Jian 金簡 proposed publishing the *Collectanea from the Wuying Hall* in 1773, whereas the first copy of the *Siku quanshu huiyao* 四庫全書薈要 (The Essentials of the Complete Library of the Four Treasuries) was finished in 1778.[36] Both of these collections included a section on astronomy and mathematics. Comparing the analytical catalogues of the astronomical and mathematical texts in these different editions reveals that Dai had nearly finalized the analytical catalogues when the *Juzhenban* version was presented to the Qianlong emperor in 1777.[37] Dai Zhen had indeed composed these drafts which were only slightly edited afterwards.

Moreover, the differences between the analytical catalogues of these three collections reveal an attempt to tame the European astronomy and mathematics transmitted since the late Ming. In the general introductory section to the astronomical and mathematical section, the *Analytical Catalogues* attribute all credit for transformation of calendrical learning to the Kangxi emperor, the center of gravity that attracted both Chinese and European astronomers and mathematicians.[38]

Unlike most astronomical books, which did not distinguish astrology from astronomy at that time, the compilers of the *Analytical Catalogues* decided to separate them. They justified this move by the separation of *tianwen zhi* 天文志 (Monograph of Astrology) and *lüli zhi* 律曆志 (Monograph of Music Pipes and Calendar) in the dynastic histories.[39] Actually the missionaries in the Astronomical Bureau had begun this trend. The officials of the *Complete Library of the Four Treasuries* might just have matched the standard protocol of astronomical practices that the Jesuits had set up in order to claim the superiority of their Chinese indigenous tradition. Another critical change is that they explicitly recognized the independent status of mathematics. Dai Zhen should be credited for this development because he had restored the textual tradition of mathematics. The compilers of the *Complete Library of the Four Treasuries* argued that astronomy had to be based on mathematics. Though astronomy and mathematics were derived from the same origin, the use of mathematics was no longer limited to astronomical purposes and it should occupy a distinct category.

[36] I will refer to these two editions as *Juzhenban* and *Huiyao* hereafter.

[37] (Zhang 1994, 6:632–644).

[38] (Yong 1983, 3:278).

[39] Ibid.

Although modern scholars have complained that Dai Zhen did a sloppy job when he recovered and commented on ancient Chinese astronomical and mathematical texts,[40] the collation of the *Gnomon of the Zhou* and the recovery of the *Nine Chapters of Mathematical Procedures* were so important that the Qianlong emperor wrote poems and prefaces to celebrate the event. In his poem to the *Gnomon of the Zhou*, Qianlong apologized that, unlike his grandfather, he had never learned astronomy and mathematics.[41] The same regret appeared again in his preface and poem to the *Nine Chapters of Mathematical Procedures*. Nevertheless, he was proud of his subjects who were able to restore these texts and commented that the quality of these newly recovered texts had actually surpassed any previous editions. He praised his grandfather, the Kangxi emperor, and asserted that the mathematical and astronomical collectanea *Essentials of Mathematical Principles* (*Shuli jingyun* 數理精蘊) that Kangxi had commissioned would function as the measure for mathematical and astronomical inquiries.[42] By placing the Kangxi emperor at the center of the stage of mathematical and astronomical learning with the Jesuits and other Chinese mathematical astronomers as invisible technicians, Qianlong reconfigured the field of astronomy and mathematics to glorify his dynasty and ascertain the classical status compiled by his Han Chinese ministers. Even though the emperor never composed any treatise for these collectaneas, he had the final say.

The compilers of the *Analytical Catalogues* followed Qianlong's lead and defended the Chinese astronomical and mathematical traditions. Comparing the different versions of the same analytical catalogues of the *Gnomon of the Zhou* revealed their defensive attitude. The two identical analytical catalogues entries for the *Gnomon of the Zhou* in the *Juzhenban* and *Huiyao* versions bear the hallmark of Dai Zhen's scholarship, since the latter interpreted the *xuanji* 璇璣 as the ecliptic pole (*huangdaoji* 黃道極) and used it to account for the sun's apparent motion.[43] Not all evidential scholars agreed with Dai's interpretation and this reference to the ecliptic pole is later omitted in the *Analytical Catalogues*. Moreover, all versions of analytical catalogues for the *Gnomon of the Zhou* cite Mei Wending's interpretation in which he used the similarities between the *Gnomon of the Zhou* and Western astronomy to show that the *Gnomon of the Zhou* was the source of the Western methods, and thus to justify the assertion of the "Chinese origin of Western learning."[44]

Moreover, a new paragraph was added to the *Analytical Catalogues* to defend the *Gnomon of the Zhou* as a source of ancient methods. Xu Guangqi had ridiculed the conversation between Rongfang 榮方 and Chenzi 陳子 in the

[40] (Qian 1983, 151–174; Guo 1990, 261–293).
[41] (Qianlong 1983a, 786:1).
[42] (Qianlong 1983b, 797:1–2).
[43] (Dai 1980, 120–121).
[44] (Chu 2005).

Gnomon of the Zhou because it implied that the earth was flat. The compilers of the *Analytical Catalogues* admitted that this paragraph was indeed foolish, but argued that the style of this conversation was very different from the rest part of the text. Therefore, it was possible that this conversation was originally part of the commentaries mistakenly interpolated into the original text. Otherwise, the comprehensiveness and subtlety of the original text had preserved the essence of the ancient methods. By dismissing the commentaries, the compilers of the *Analytical Catalogues* were able to maintain the integrity of the *Gnomon of the Zhou* and preserve its status as the origins of mathematics and astronomy in both East and West.[45]

The newly restored *Nine Chapters of Mathematical Procedures* functioned as the origin of mathematics. The compilers of the *Analytical Catalogues* asserted that no mathematical method was older than this book. Despite improvements made in the new methods, no change of methods could escape the scope of this ancient text.[46] After a bibliographical investigation, the compilers asserted that the recovered edition of the *Nine Chapters of Mathematical Procedures* was indeed the Song edition which had sunk into obscurity since the Ming. They asserted: "It is owing to the advancement of our August dynasty that this long lost text reappears today. It seems that its obscurity and appearance is determined by destiny; it is not accidental."[47] Thus, according to the compilers of the *Analytical Catalogues*, the Qing dynasty could take credit for the rediscovery of the origins of Chinese mathematics.

The significance of the *Calendrical Treatises of the Chongzhen Reign*, which was recompiled again under the name of *Computation Treatises in Accordance with the New Methods*(*Xinfa suanshu* 新法算書), was also reevaluated against the background of the general trend of reshaping mathematical and astronomical studies during the year when the *Complete Library of the Four Treasuries* was compiled. In the *Analytical Catalogues*, the *Computation Treatises in Accordance with the New Methods* were only part of the historical narrative about how the new calendar had been introduced to the Ming, who did not adopt it, and thus paved the way for the mandate of the Qing.[48]

Such a reconfiguration of the significance of scientific works transmitted into China from Europe appeared not only in astronomy but also in mathematics. The analytical catalogue in the earlier *Huiyao* version of the *Essentials of Mathematical Principles* simply stated its mathematical contents.[49] The *Analytical Catalogues* version, which contained the content of the *Huiyao* version, is far more complicated and implies using these collectanea as the measure to attenuate the dispute between Chinese and Western mathematics. The

[45] (*Zhoubi* 1899, 395: 1a–3a. Huiyao mulu 1988, 1:498–50. Yong 1983, 3:287).

[46] (Chu 2005).

[47] (*Jiuzhang* 1899, 396: 1a–2b. Yong 1983, 3:304–305).

[48] (Yong 1983, 3:288–9. Chu 2007).

[49] (*Huiyao mulu*, 1:506).

compilers of the *Analytical Catalogues* suggested that the *Essentials of Mathematical Principles* had bridged differences between East and West, and had settled pros and cons between past and present. While criticizing the old Chinese methods for complicating the methods of solving systems of simultaneous linear equations, adopting the value three for the approximation of π, and being unable to comprehend the principle of algebra, the compilers of the *Analytical Catalogues* failed to mention that the *Essentials of Mathematical Principles* had applied the mathematics transmitted from the West to solve ancient Chinese mathematical problems. Moreover, the *Analytical Catalogues* also complained that the translation of Euclid's *Elements* was not continued after the decease of Xu Guangqi and Li Zhizao, and praised the *Essentials of Mathematical Principles* for compensating this failure. The compilers further argued, the *Essentials of Mathematical Principles* explained the principle of logarithms and made the tables of logarithms available to simplify calculations. In fact, the *Essentials of Mathematical Principles* was a result of the cooperation of Chinese and European mathematicians and astronomers at court. Kangxi made every effort to update the knowledge transmitted from the West and commissioned this project. The compilers of the *Analytical Catalogues* therefore attributed all the credit to this emperor.

However, the progress of knowledge did not cease in the Kangxi era. In 1742, the Qianlong emperor again compiled another astronomical collectanea *Compendium of Calendrical Studies* (*Lixiang kaocheng houbian* 曆象考成後編) to update astronomical knowledge. According to the *Huiyao* version of the analytical catalogue, the original motive to recompile these collectanea was to adjust errors caused by the precession of the equinoxes and to explicate the uses of the astronomical tables for predicting eclipses.[50] The compilers of the *Analytical Catalogues* further elaborated the *Huiyao* version of the analytical catalogue and clarified why a recompilation of these astronomical collectanea was necessary. They claimed that although the *Compendium of Calendrical Studies* (*Lixiang kaocheng* 曆象考成) had revealed the methods for all ages, astronomical observation had become more and more precise, and mathematical methods more refined. Therefore, Tycho Brahe's model, in which the sun revolved around the earth, and all the planets around the sun, was no longer sufficient and elliptic orbits had to be introduced. The newly established methods did not contradict the old ones, however. In fact, a comparison of these two methods would reveal the subtlety of both. The Principle (*li* 理) of the new methods was thus a continuation of the methods the Kangxi emperor had set up just as sagely emperors inherited one from another. In their narrative, the compilers of the *Analytical Catalogues* justify the necessity for recompiling new astronomical collectanea by the advancement of calendrical techniques while the eternal characteristic of the Principle legitimated the unchanging status of the Kangxi emperor.

[50] (*Huiyao mulu*, 1:506–507).

In addition to glorifying the imperially commissioned collectanea whose contents mostly derived from European astronomy and mathematics transmitted since the late Ming, the compilers of the *Analytical Catalogues* endeavored to eradicate the religious implications associated with the new Western science. The compilers of the *Analytical Catalogues* maintained distinct categories for astronomy and mathematics. They perpetuated the trend begun in the late Ming that excluded astrology and numerology from astronomy and mathematics. This strategy also equally applied to the works of Western astronomy and mathematics. For example, the compilers of the *Analytical Catalogues* thought that the preface to the Manuel Dias' (1574–1659) *Tianwen lüe* 天問略 (Epitome of Questions on the Heavens) would only attract mean and stupid people to the religion and expunged this preface in the *Analytical Catalogues*.[51]

The sterilization of European science was not limited to the Western works. The implication of the fact that the calendar the Qing used was actually imported from "the West," as Schall had once attempted to claim, also needed to be erased. The work of Jiang Yong 江永, one of the most renowned evidential scholars and also a keen supporter of Western astronomy, was also scrutinized during the compilation of *Complete Library of the Four Treasuries*. Jiang dedicated his major astronomical and mathematical work *Yi Mei* 翼梅 (*Wings of Mei* [Wending]) to Mei Wending as a salute.[52] In 1741, Jiang Yong seized an opportunity to meet Mei Juecheng 梅瑴成 (1681–1763), Mei Wending's grandson and the leader of Confucian astronomers in the capital. They had a long discussion and exchanged information. Mei Juecheng asked for permission to duplicate *Wings of Mei*, and Jiang asked for logarithm tables in return. However, an initially good impression turned into a feud. Mei Juecheng later expressed his dissatisfaction with Jiang's *Wings of Mei* and refused to preface it. He criticized Jiang for not understanding the profound significance of Mei Wending's works in promoting the Sages' teaching and in refuting the devilish teaching of the Westerners. Jiang Yong responded with a second preface to the *Wings of Mei* in which he described his encounter with Mei Juecheng and his own position regarding Western astronomy. Mei Juecheng attempted to remind Jiang of the Chinese origins of Western astronomy. However, Jiang ignored Mei Juecheng's advice and attributed the prosperity of contemporary astronomy to the contribution of the Westerners.[53]

Later, Qian Daxin 錢大昕 (1728–1804) came to believe that Jiang had written the *Wings of Mei* only to fault Mei Wending and expressed his dissatisfaction about the work to Dai Zhen.[54] When Dai Zhen, who was responsible for adding the *Wings of Mei* to the *Complete Library of the Four Treasuries*, became aware of these objections, he changed the book's title from *Wings of*

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[51] (Yong 1983, 3:287).

[52] (Jiang 1936, preface II 1–2).

[53] (Ibid., 3–4. Chu 1997a,b).

[54] (Qian 1989, 320).

Mei to *Mathematical Learning* (*Shuxue* 數學) and expunged Jiang's two prefaces to the work.[55] Through these editorial changes, Dai Zhen covered the disagreements among Chinese astronomers, obscured the fact that some Confucian literati still admired the astronomical and mathematical achievements of the foreigners, neutralized the politics of studying nature and dressed Jiang Yong's work in the shroud of "pure" mathematical discourse. The compilers of the *Analytical Catalogues* also praised Jiang Yong's achievement without mentioning the complex politics behind the inclusion of Jiang's work and exclusion of his prefaces. They represented Jiang as a faithful follower of the imperially commissioned *Compendium of Calendrical Studies* (which Jiang indeed mentioned in his work), aiming at improving astronomical and mathematical learning. Jiang was simply another loyal subject dedicating his career to the glory of the empire.

The *Complete Library of the Four Treasuries* enabled Confucian astronomers to restore their own tradition and reconfigure the meaning of astronomy and mathematics in the eighteenth century. Dai Zhen's recovery of ancient mathematical texts from the *Grand Compendium of the Yongle Reign* marked a point of departure from which Confucian astronomers and mathematicians began a trend of applying Western mathematics to their research of ancient Chinese mathematics. In addition, compiling the *Complete Library of the Four Treasuries* offered an opportunity to reshape the meaning of Western scientific knowledge. The officials downplayed its significance, purged it of religious implications, and placed it in the service of the throne. The Western knowledge was finally tamed and became merely an appendix to the astronomical and mathematical collectanea compiled under the imperial auspiciousness.

Conclusion

The struggle in the field of calendrical studies, so crucial to the legitimacy of any dynasty, was largely a competition of defining classical texts in seventeenth and eighteenth century China. Like the canonization of the Confucian classical edifice, this struggle revolved around the imperial power which was the final arbitrator of what classics were. To attract the attention of the throne, the Jesuits and their Chinese associates translated Western mathematics and astronomy with the attempt to replace the indigenous tradition, and they anchored their mission in the bureaucratic system. They claimed that the superiority of their knowledge was informed by a higher truth while downplaying the significance of the Chinese mathematical and astronomical tradition, criticizing its key historical figures and faulting its dearth of useful information. They suggested to the emperors that the appearance of the calendar should remain Chinese, while Western techniques should be used to craft it. After the Qing

[55] (Ruan 1982, 528).

conquest, Adam Schall successfully had Jesuit astronomy canonized by having the emperor archive his collectanea in the Imperial Historical Archive. Western astronomy then became orthodox. As a result, China experienced an unprecedented growth of mathematical and astronomical literature during the seventeenth and eighteenth centuries.

Nevertheless, the emperors of the late Ming and Qing, though supporting voluminous collections of astronomy and mathematics, were quite cautious about the implications of adopting a calendar from the West and endeavored to locate calendrical reform within the network of the bureaucratic machinery without mentioning its religious implications. They were ready to accept the canonization of texts from both sides as long as these texts served their interests.

Confucian literati interested in astronomy and mathematics soon kept in tandem with the up-to-date knowledge and employed it in their own research. They, however, were aware of the religious implications and the extra-religious motivation of the Western calendar. They also noticed that to compete with the newly canonized Western science, they had to root their knowledge claims on a firm material base, a set of indigenous classics with equal authority. Searching for the lost tradition thus became a main concern of these literati. However, their project of reviving indigenous traditions of astronomy and mathematics did not materialize until the *Complete Library of the Four Treasuries* project took shape and a large amount of ancient texts housed in the court became available to them.

Dai Zhen was championed as the cultural hero of this effort of rejuvenating the indigenous tradition. His recompilation and collation of mathematical and astronomical texts from the *Grand Compendium of the Yongle Emperor* in fact created new objects, the ancient scientific texts, which, however, were presented as if he merely revived the already existing tradition. These new materials enabled Confucian literati to combat European missionaries serving at court as astronomical experts on two fronts. On the ideological front, the assertion that Western learning originated in China was grounded on the material evidence of books. On the research front, Confucian literati interested in mathematics applied Western knowledge to carry out their research of ancient wisdom and develop the theory of equations. Small wonder that Dai Zhen's achievements of rediscovering ancient texts were considered a "scientific revolution" by his contemporaries in a milieu of evidential scholarship, except that the new objects produced in this revolution were re-canonized old texts.

The *Complete Library of the Four Treasuries* largely diluted the influences of Western astronomical and mathematical knowledge, turning it into one of the branches of the Chinese knowledge and rewrote Adam Schall's historical narrative by reversing the origins of this knowledge. In this historical process, both the Manchu emperors and the Chinese literati purged the Qing calendar of political and religious implications that had been produced by the missionaries and reined in its meaning by replacing the Western canons the Jesuits had produced with their newly assembled tradition of indigenous scientific classics.

It is interesting to compare the strategies of canonization of both parties. The Jesuits emphasized their knowledge as new and efficacious, and therefore, worthy of the status of classics, whereas Chinese literati stressed the ancient and indigenous aspects of their texts to justify their competing claim for classics. Both parties possessed a "material consciousness" that only by inserting their texts in a prestigious imperial collection, a textual arsenal, could they defeat their rivals. Both of them also maintained a high "historical consciousness" to bestow on their texts a historical narrative so as to construct a classical taste of their texts. Scientific classics thus are not a natural product wrought by the internal quality of texts. They are material objects shaped by a power process which eventually leaves its traces on the memory of the later generations who take the historical narratives embedded in these texts as part of the history of science.

Annexes

Table 1 Remains of mathematical texts in the *Yongle dadian*

Title	Author
Dingju suanfa 丁巨算法	
Jiuzhang suanjing 九章算經	
Riyong suanfa 日用算法	Yang Hui 楊輝
Quanneng ji 全能集	Jia Tong 賈通
Xiahou Yang suanjing 夏侯陽算經	
Sunzi suanjing 孫子算經	
Wucao suanjing 五曹算經	
Tongyuan suanfa 通原算法	Yang Gong 嚴恭
Toulian xicao 透簾細草	
Xiangming suanfa 詳明算法	
Xiangjie suanfa 詳解算法	Yang Hui 楊輝
Zhaiqi suanfa 摘奇算法	Yang Hui 楊輝
Shuxue jiuzhang 數學九章	Qin Jiushao 秦九韶
Qinnang qiyuan 錦囊啟源	

Table 2 Mathematical texts in the *Wuyingdian juzhenban congshu*

Title	Supervisor	Editor
Jiuzhang suanshu 九章算術		
Sunzi suanjing 孫子算經	Lu Xixiong 陸錫熊 Ji Yun 紀昀	Dai Zhen 戴震
Haidao suanjing 海島算經	Lu Xixiong 陸錫熊 Ji Yun 紀昀	Dai Zhen 戴震
Wucao suanjing 五曹算經	Lu Xixiong 陸錫熊 Ji Yun 紀昀	Dai Zhen 戴震
Xiahou Yang suanjing 夏侯陽算經	Lu Xixiong 陸錫熊 Ji Yun 紀昀	Dai Zhen 戴震
Wujing suanshu 五經算術	Lu Xixiong 陸錫熊 Ji Yun 紀昀	Dai Zhen 戴震
Zhoubi suanjing 周髀算經		
Yinyi 音義		

Table 3 Mathematical texts in the *Siku quanshu*

Title	Juan	Restored from/ Submitted by	Author
Jiuzhang suanshu 九章算術	9	Grand Compendium of the Yongle Emperor	
Sunzi suanjing 孫子算經	3	Grand Compendium of the Yongle Emperor	
Shushu jiyi 術數記遺一卷	1	Liangjiang Governor-general	Han 漢 Xu Yue 徐岳 Bei Zhou 北周 Zhen Luan 甄鸞註
Haidao suanjing 海島算經	1	Grand Compendium of the Yongle Emperor	Jin 晉 Liu Hui 劉徽 Tang 唐 Li Chunfeng et al., 李淳風等註
Wucao suanjing 五曹算經	5	Grand Compendium of the Yongle Emperor	
Xiahou yang suanjing 夏侯陽算經	3	Grand Compendium of the Yongle Emperor	
Wujing suanshu 五經算術	2	Grand Compendium of the Yongle Emperor	Bei Zhou 北周 Zhen Luan 甄鸞 Tang 唐 Li Chunfeng 李淳風註
Zhang Qiujian suanjing 張邱建算經	3	Wang Jei	Zhen Luan 甄鸞註
Jigu suanjing 緝古算經	1	Wang Jei	Tang 唐 Wang Xiaotong 王孝通
Shuxue jiuzhang 數學九章	18	Grand Compendium of the Yongle Emperor	Song 宋 Qin Jiushao 秦九韶
Ceyuan haijing 測圓海鏡	12	Li Huang	Yuan 元 Li Zhi 李冶
Ceyuan haijing fenlai shishu 測圓海鏡分類釋術	10	Tianyige Library	Ming 明 Gu Yingxiang 顧應祥
Yigu yanduan 益古演段	3	Grand Compendium of the Yongle Emperor	Yuan 元 Li Zhi 李冶
Hushi suanshu 弧矢算術	1	Tianyige Library	Ming 明 Gu Yingxiang 顧應祥
Tongwen suanzhi qianbian 同文算指前編	2	Liangjiang Governor-general	Ming 明 Li Zhizao 李之藻
Tongbian 通編	8		
Jihe yuanben 幾何原本	6	Liangjiang Governor-general	Euclid, Ricci trans.
Yuzhi shuli jingyun 御製數理精蘊	53		
Jihe lunyue 幾何論約	7	Imperial House 內府	Qing 清 Du Zhigeng 杜知耕
Shuxue yao 數學鑰	6	Imperial House	Qing 清 Du Zhigeng 杜知耕
Shudu yan 數度衍 Fulu 附錄	24 1	Liangjiang Governor-general	Qing 清 Fang Zhongtong 方中通
Gougu yinmeng 句股引蒙	5	Zhejiang Governor	Qing 清 Chen Xu 陳訏

Table 3 (continued)

Title	Juan	Restored from/ Submitted by	Author
Gougu juce jieyuan 句股矩測解原	2	Wang Qishu	Qing 清 Huang Baijia 黃百家
Shaoguang buyi 少廣補遺	1	Liangjiang Governor-general	Qing 清 Chen Shiren 陳世仁
Zhuangshi suanxue 莊氏算學	8	Fujian Governor	Qing 清 Zhuang Hengyang 莊亨陽
Jiuzhang luyao 九章錄要	12	Zhejiang Governor	Qing 清 Tu Wenyi 屠文漪

Table 4 Astronomical texts in the *Siku quanshu*

Title	Juan	Restored from/ Submitted by	Author
Zhoubi suanjing 周髀算經 Yinyi 音義	2 1	Grand Compendium of the Yongle Emperor	
Xin yixiang fayao 新儀象法要	3	Imperial House	Song 宋 Su Song 蘇頌
Liujing tianwen bian 六經天文編	2	Zhili Governor-general	Song 宋 WangYinglin 王應麟
Yuanben gexiang xin shu 原本革象新書	5	Grand Compendium of the Yongle Emperor	Zhao Yuandu 趙緣督
Chongxiu gexiang xin shu 重修革象新書	2	Tianyige Library	Ming 明 Wang Yi 王禕 ed.
Qizheng tuibu 七政推步	7	Tianyige Library	Bei lin 貝琳
Shengshou wannian li 聖壽萬年歷 Luli rongtong 律歷融通	8 4	Zhejiang Governor	Ming 明 Zhu Zaiyu 朱載堉
Gujin luli kao 古今律歷考	72	Zhejiang Governor	Ming 明 XingYunlu 邢雲路
Qiankun tiyi 乾坤體義	2	Liangjiang Governor-general	Ming 明 Matteo Ricci (Li Madou 利瑪竇)
Biaodu shuo 表度說	1	Liangjiang Governor-general	Sabatino de Ursis (Xiong Sanba 熊三拔)
Jianping yishuo 簡平儀說	1	Liangjiang Governor-general	Sabatino de Ursis (Xiong Sanba 熊三拔)
Tianwen lue 天問略	1	Liangjiang Governor-general	Manuel Dias (Yang Manuo 陽瑪諾)
Xinfa suanshu 新法算書	100	Chen Chanqi	
Celiang fayi 測量法義 Celiang yitong 測量異同	1 1	Liangjiang Governor-general	

Table 4 (continued)

Title	Juan	Restored from/ Submitted by	Author
Gougu yi 句股義	1		Ming 明 Xu Guangqi 徐光啟. Matteo Ricci (Li Madou 利瑪竇)
Hungai tongxian tushuo 渾蓋通憲圖說	2	Presented by Liangjiang Governor-general	Ming 明 Li Zhizao 李之藻
Huanrong jiaoyi 圜容較義	1	Liangjiang Governor-general	Ming 明 Li Zhizao 李之藻
Liti lue 歷體略	3	Anhui Governor	Ming 明 WangYingming 王英明
Yuding lixiang kaocheng 御定歷象考成	42		
Yuding Yixiang kaocheng 御定儀象考成	32		
Yuding lixiang kaocheng houbian 御定歷象考成後編	10		
Xiaoan xinfa 曉菴新法	6	Shandong Governor	Qing 清 Wang Xichan 王錫闡
Zhongxing pu 中星譜	1	Zhejiang Governor	Qing 清 Hu Zhan 胡亶
Tianjing huowen qianji 天經或問前集	4	Fujian Governor	Qing 清 You Yi 游藝
Tianbu zhenyuan 天步真原	1	Wang Qishu	Qing 清 Xue Fengzuo 薛鳳祚
Tianxue huitong 天學會通	1	Wang Qishu	Qing 清 Xue Fengzuo 薛鳳祚
Lisuan quanshu 歷算全書	60	Wang Qishu	Qing 清 Mei Wending 梅文鼎
Datong lizhi 大統歷志	8	Lianghuai Salt Administrator	Qing 清 Mei Wending 梅文鼎
Fulu 附錄	1		
Wuan lisuan shuji 勿菴歷算書記	1	Wu Yuchi	Qing 清 Mei Wending 梅文鼎
Zhongxi jingxing tongyi kao 中西經星同異考	1	Anhui Governor	Qing 清 Mei Wending 梅文鼏
Quanshi rizhi yuanliu 全史日至源流	32	Huanan Governor	Qing 清 Xu Bozheng 許伯政
Shuxue 數學	8	Anhui Governor	Qing 清 Jiang Yong 江永
Xu 續	1		

Table 5 Mathematical texts in the *Siku quanshu cunmu*

Title	juan	Submitted by	Author
Suanfa tongzong 算法統宗	17	Imperial House	Ming 明 Cheng Dawei 程大位
Gougu shu 句股述	2	Wu Yuchi	Qing 清 Chen Xu 陳訏
Yinshan bishi 隱山鄙事	4	Zhejiang Governor	Qing 清 Li Zijin 李子金
Weijing zhenzhi 圍徑真旨	na.	Anhui Governor	Qing 清 Gu Changfa 顧長發

Table 6 Astronomical texts in the *Siku quanshu cunmu*

Title	juan	Submitted by	Author
Xing jing 星經	2	Liangjiang Governor	Anonymous
Butian ge 步天歌	7	Liangjiang Governor	Anonymous
Qingluo li 青羅歷	na	Tianyige Library	Anonymous
Guanli kelou tu 官歷刻漏圖	2	Grand Compendium of the Yongle Emperor	Song 宋 Wang Pu 王普
Xingxiang kao 星象考	1	Cheng Jifang	Song 宋 Zou hui 鄒淮
Tianwen jingyi fu 天文精義賦	4	Tianyige Library	Yue Xizai 岳熙載
Tianxin fuyao 天心復要	3	Tianyige Library	Ming 明 Bao Tai 鮑泰
Taiyang taiyin tonggui 太陽太陰通軌	na	Bao Shigong	Ming 明 Ge Yongling 戈永齡
Xiangwei huibian 象緯彙編	2	Tianyige Library	Ming 明 Han Wanzhong 韓萬鍾
Wushen lichun kaozheng 戊申立春考證	1	Liangjiang Governor-general	Ming 明 Xing Yunlu 邢雲路
Xingli shiyi 星歷釋義	2	Bao Shigong	Ming 明 Lin Zushu 林祖述
Zhezhong lifa 折衷歷法	13	Liangjiang Governor-general	Ming 明 Zhu Zhongfu 朱仲福
Weitan 緯譚	1	Fujian Governor	Ming 明 Wei Rui 魏濬
Xuanye jing 宣夜經	na	Jiangsu Governor	Ming 明 Ke Zhongjung 柯仲炯
Jiuhuan shitu 九圜史圖	1	Wang qishu	Ming 明 Zhao Yiguang 趙宧光
Liuhe mantu 六匌曼圖	1		
Gaizai tuxian 蓋載圖憲	1	Li Shouqian	Ming 明 Xu Xuchen 許胥臣
Tianguan yi 天官翼	na	Zhejiang Governor	Ming 明 Dong Yue 董說
Tianjing huowen houji天經或問後集	na	Gujian Governor	Qing 清 Yo Yi 游藝
Xuanji yishu 璇璣遺述	7	Liangjiang Governor-general	Qing 清 Jie Xuan 揭暄
Qinshi qizheng quanshu 秦氏七政全書	na	Jiangsu Governor	Qing 清 Qin Wenyaun 秦文淵
Lisuan quanshu 歷算全書	62	Anhui Governor	Qing 清 Mei Juecheng 梅穀成
Wanqing lou tubian 萬青樓圖編	16	Zhang Xinien	Qing 清 Shao Angxiao 邵昂霄
Baxian cebiao tushuo 八線測表圖說	1	Liangjiang Governor-general	Qing 清 Yu Xi 余熙

Table 7 Mathematical texts in *Siku huiyao*

Zhoubi suanjing 周髀算經
Wujing suanshu 五經算術
Xin yixiang fayao 新儀象法要
Yuzhi lulü zhengyi 御製律呂正義
Ceyuan haijing fenlei shishu 測圓海鏡分類釋術
Yuzhi lixiang kaocheng 御製歷象考成
Yuzhi shuli jingyun 御製數理精
Qinding yixiang kaocheng 欽定儀象考成
Yuzhi lulü zhengyi houbian 御製律呂正義後編
Yuzhi lixiang kaocheng houbian 御製歷象考成後編

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Part II
Reading Actors' Collections and Archives, Reading Beyond Collections and Archives That Shaped the Present Day Historiography: New Perspectives on the History of Science in Asia

A Chinese Canon in Mathematics and Its Two Layers of Commentaries: Reading a Collection of Texts as Shaped by Actors

Karine Chemla

The earliest mathematical books written in Chinese that have been handed-down through the written tradition share a common feature: they were all granted the status of "canons (*jing*)" some time after their completion.[1] Moreover, in correlation with this status, in the seventh century as well as, in some cases, some centuries earlier, commentaries were composed on them. This chapter focuses on one of these canons, *The Nine Chapters on Mathematical Procedures*, as well as its two earliest extant commentaries. *The Nine Chapters* is one of the oldest canons that has come down to us. It has played a central role both in the history and the historiography of mathematics in China. The main questions addressed in this chapter were inspired by some remarks regarding the way in which *The Nine Chapters* and its commentaries have been handed down.

After the book was compiled, probably in the first century of the Common Era,[2] as for any other classic, commentaries on it were written. Of all those that were composed until the seventh century and for which we have evidence, the texts of only two survive, and they have been handed down through the written tradition *with* the text of *The Nine Chapters* itself. The oldest of these two

[1] Evidence supporting this assertion is supplied in Appendix 1 in (Chemla 2008b, 41–44). The assertion requires qualification, which is also provided there. These nuances are not important here.

[2] I opt for this dating, see my arguments in (Chemla and Guo Shuchun 2004, 475 sq.). However the date of composition of *The Nine Chapters* —this is how I shall abbreviate the title in this chapter— is still a matter of debate. For a presentation of the various stands, see chapter B, by Guo Shuchun, in (Chemla and Guo Shuchun 2004). The latter book provides a critical edition and translation on which I shall rely here. I have pleasure in thanking all the other authors in this volume for the remarks they made on my chapter. They considerably helped me clarify my argument. I am also grateful to Maurice Shukla and Richard Kennedy for their help in polishing the English in the paper. I am nevertheless fully responsible for the remaining shortcomings.

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F. Bretelle-Establet (ed.), *Looking at It from Asia: The Processes that Shaped the Sources of History of Science*, Boston Studies in the Philosophy of Science 265, DOI 10.1007/978-90-481-3676-6_6,

commentaries, completed by Liu Hui 劉徽 in 263,[3] is also the earliest extant document bearing witness to the status of *The Nine Chapters* as a "canon."[4] The second extant commentary was composed by a group of scholars working under the supervision of Li Chunfeng 李春風 (602–670) within the context of a larger project commissioned by the Emperor: editing, and commenting upon, an anthology of *Ten Canons of Mathematics* (*Suanjing shishu*), including some important ancient commentaries on them, the outcome of which was presented to the throne in 656.[5] In fact, as regards *The Nine Chapters*, this commentary, to which for the sake of simplicity I shall refer as "Li Chunfeng's commentary," is a subcommentary that has bearing on both the canon and Liu Hui's commentary on it.

The key remark for us here is that we do have ancient editions of *The Nine Chapters* independent of the anthology, but we are not aware of any that have survived and do not contain Liu Hui's commentary and Li Chunfeng's subcommentary. In other words, with *The Nine Chapters* and these commentaries, the written tradition in China crystallized a collection of texts in a certain form. This collection took shape in the seventh century in relation to the constitution of an anthology, even though it enjoyed a relative autonomy vis-à-vis the anthology.[6] Moreover, within the collection, each of these texts had an

[3] Most of what we know concerning Liu Hui's biography derives from the chapters entitled "Monograph on the musical scale and the calendar," in the *History of the Jin* and the *History of the Sui*. Both chapters were composed by Li Chunfeng (602–670). These sources give further important information: see note 133, in my annotations to the French translation, in (Chemla and Guo Shuchun 2004, 774–775). Li Chunfeng's name is associated to the second extant commentary (see below). On the process of the compilation of official histories of previous dynasties in the seventh century, see Chapter 5 in (McMullen 1988).

[4] Arguments for this claim are given in Appendix 1 in (Chemla 2008b).

[5] Appendix 1 gives the list of books brought together in the anthology. On the general issue of editing canons, selecting earlier commentaries and composing new commentaries in seventh century China, see Chapter 2 in (McMullen 1988). The author analyzes the involvement of state institutions in this process. The anthology was to be used, shortly after the commentary had been completed, as a set of textbooks for mathematical education and examinations in the Tang dynasty state teaching institutions. To complete the set, two additional treatises were employed as textbooks. Let us mention the only one that has survived, since it will be useful below as an example of text that, at least at the beginning, has been handed down in relation to the institution of the University and not its inclusion in the set of canons: the *Memoir on the Methods of Numbering* (*Shushu jiyi* 數術記遺) composed by Xu Yue (fl. ca. 220). The dating and authorship of the book is discussed in (Volkov 1994). Except for that writing, all the mathematical books that have been handed down in China were canons selected to be included in this anthology and used in the government education system at the time. The use of these textbooks for teaching and examining students is discussed in (Siu and Volkov 1999). A table giving information about these texts and a description of their main features can be found in (Martzloff 1997, 123–141). In recent decades, two critical editions of the anthology have appeared: (Qian Baocong 錢寶琮 1963; Guo Shuchun 郭書春 and Liu Dun劉鈍 1998). In what follows, I shall abbreviate the title of the anthology into *Ten Canons*.

[6] For the sake of clarity, in what follows, I shall restrict the use of the term "collection" to refer to this set of texts, whereas the term "anthology" will systematically designate the *Ten Canons* with the commentaries included in the seventh century.

established status with respect to the others. Furthermore, none of these texts appears to have enjoyed enough autonomy to have survived separately. Among other things, these facts indicate how essential for the subsequent readers and users of *The Nine Chapters* the two commentaries were felt to be.

The foregoing remarks lead me to the key issues addressed in this chapter. Past actors shaped a collection of texts into a single entity. How can we account for the cohesion of the whole? Further, what are the benefits that historians can derive from reading the collection as such? In sum, how can we today approach a collection of texts shaped in this way by past actors ? These will be the general questions that I shall consider in the specific case of *The Nine Chapters* and its two most ancient extant commentaries.[7]

In a first section—the most important in fact—I shall analyze the historical process through which this collection took shape and has been handed down to us. My main aim will be to establish that the collection, as I describe above, soon appeared to Chinese readers as constituting an indivisible whole. Incidentally, I shall also stress the extent to which the earliest extant mathematical sources handed down through the written tradition were shaped by a sequence of projects all of which were carried out by governmental institutions and under imperial order. In a second section, I shall argue that in the nineteenth and twentieth centuries either historians of mathematics focused on the canon or, when they considered the commentaries as worthy of mention, they read them and used them as texts *subsequent* to *The Nine Chapters*, but not as *commentaries on The Nine Chapters*. In other words, the collection of texts was dismantled and treated as separate pieces, the canon having first monopolized attention of historians. The status of the texts as such was not taken into account when they were interpreted, at least if we consider the kind of emphasis placed on the canon was not an adequate reflection of its genre as "canon"—an issue to which I come back later. As regards the commentaries, my claim is that reading them as merely subsequent texts amounted not to reading them as commentaries, that is, as writings owing their existence to the text commented upon and representing the fulfilment of a

[7] From the above description, it is clear that the same questions could be raised with respect to the *Ten Canons*. Indeed, this anthology also represents a set of texts compiled, not by historians but by actors and, as we see below, handed down in the form of an anthology. Note, however, that, although the same research program could be followed, we can expect the answers to be different, since the cohesion of the anthology does not translate in the same way in the set of extant sources as it does for *The Nine Chapters* and its commentaries. From early on, as we shall see, separate editions of our collection of texts appeared. These editions show that the collection was more strongly felt to be a coherent and independent whole. Addressing the question first in relation to *The Nine Chapters* is an indispensible prerequisite before studying the *Ten Canons* from a similar perspective. I plan to address the latter issue in another publication. In addition, it is only among the *Ten Canons,* for *The Gnomon of the Zhou [Dynasty]*, and perhaps also *The Mathematical Procedures of the Five Canons*, which appears to have been much less important historically, that we could carry out a research program similar to the one sketched out in this chapter for *The Nine Chapters*. The reason is that these two canons are the only other ones for which layers of commentaries have accumulated and have been handed down as such. I also plan to return to these canons in subsequent publications.

project with respect to this text. In addition, in this second section, I shall attempt to account for why only parts of the commentaries were dealt with at different time periods and how these parts were analyzed.

By contrast, in a third section, I shall suggest what is at stake in restoring the collection to the cohesion and the structure past actors gave it in China. In particular, I shall focus on commentaries *as* commentaries, a status that was granted to them by past actors, but has in my view mainly been neglected by historiography. As a consequence, we shall be in a position to address the issue of the "nature" of the canon as text, as it can be approached on the basis of the testimonies provided by the commentaries.

A Historical Approach to the Constitution of A Collection

Elements of the textual history of *The Nine Chapters* after the seventh century edition will prove useful in better appreciating how the collection composed of *The Nine Chapters* and the two commentaries has been shaped over the centuries and why this shaping is interesting to take into account in historiography.[8] If my focus remains on the history of this transmission, I shall also provide information on the transmission of the whole anthology to which *The Nine Chapters* was attached, the main point being to understand how the collection acquired cohesion as well as autonomy from this whole.

The Collection and the Anthology During the Song Dynasty

After the completion of the seventh century project, under Li Chunfeng's supervision, the subsequent known edition of *The Nine Chapters*, along with a woodblock printing, was carried out in 1084 by a state institution: the Imperial Library (*Bishusheng* 秘书省). In it, the text of *The Nine Chapters* is interwoven with Liu Hui's and Li Chunfeng's commentaries. Moreover, this publication took place within the scope of a more global project to edit and print the *Ten Canons* of the past, including the commentaries selected or composed in the seventh century.[9]

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[8] To help the reader follow my analysis, in Appendix 2, I have provided a sketch of the earliest stages in the transmission of the collection. A more detailed account is given in chapter B, by Guo Shuchun, in (Chemla and Guo Shuchun 2004). I limit myself to what is essential for me here.

[9] On the Imperial Library during the Northern Song, see (Winkelman 1974, 5–10). More generally, the reader is referred to this publication for a description of the imperial holdings and cataloguing of books during the Song. Source material on the various printings of the mathematical canons during the Song dynasty is collected in (Li Yan 1954, 89–92). Li Yan emphasizes in particular the connection that existed, in his view, between the project of resuming examination in mathematics during the Northern Song dynasty and the 1084 printing of the canons. However, finding conflicting evidence regarding whether the auxiliary

There does not seem to remain today any fragment of this first printing of the anthology. In fact, as early as the beginning of the thirteenth century, when the civil servant Bao Huanzhi 鮑澣之 undertook to print the *Ten Canons* again,[10] the eleventh century edition of the set of canons was not available to him as such. Those of its volumes that Bao Huanzhi could find and use as a basis for his reprint appear to have circulated separately.

These conclusions derive from the evidence we have concerning Bao Huanzhi's editorial project, which is more richly documented. In fact, six volumes of his edition of the *Ten Canons* are still extant today, at least partially—they constitute the earliest surviving edition of these canons (Shanghai tushuguan and Beijing daxue tushuguan 1980)—and in addition, four of the postfaces that he added to each book printed have survived to this day.[11] In each of them, Bao Huanzhi made clear how he had obtained a copy of the book and on the basis of which pieces of evidence he determined the identity of its author and its

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book *Memoir on the Methods of Numbering* (*Shushu jiyi*) was also printed in 1084 or not, he refrains from concluding on this point. (Qian Baocong 錢寶琮 1963, vol.1, 1–9) describes the history of the editorial projects that regularly republished the *Ten Canons*. In particular, Qian explains how in the eleventh century, the text of two canons, the *Zhuishu* and the *Xiahou Yang suanjing*, had already been irretrievably lost and how a mathematical book probably composed in the eighth century was mistakenly substituted for the latter, see (Qian Baocong 錢寶琮 1963, vol. 2, 551–552). This last detail shows the impact of the intention of retrieving the canons on the printing of historical mathematical texts.

[10] The "Monograph on the musical scale and the calendar" of the *History of the Song* (*Songshi*) ((Yang Jialuo (ed.) 楊家駱主編 1978, 4: 2892–2894) documents how at the end of the twelfth century and the beginning of the thirteenth century, the official Bao Huanzhi worked within the framework of state institutions on a reform of the calendar and designed the *Kaixi* calendar, enacted in 1207. This calendar was an improvement to the *Tongtian* calendar, which had been designed by Yang Zhongfu 杨忠辅 and enacted in 1199. It was a few years later that Bao Huanzhi dealt with the reedition of the anthology. More information on Bao Huanzhi's career as a civil servant is provided in the introduction to the reprint of the extant sections of his edition of the *Ten Canons*, in (Shanghai tushuguan and Beijing daxue tushuguan 1980), placed at the beginning of the reprint of the *Shushu jiyi*.

[11] The postface to *The Gnomon of the Zhou* has survived in the part of the Southern Song woodblock print that has been handed down. The same holds true for the postface to the *Memoir on the Methods of Numbering*, a book used as a textbook complementing the *Ten Canons* in Tang dynasty teaching institutions (see Footnote 5) and reprinted by Bao Huanzhi as appended to the anthology of Canons. This postface is published with a text entitled *Source and development of mathematics* (*Suanxue yuanliu* 算學源流), which sketches a history of mathematical examinations and teaching institutions in China. The postface to *The Nine Chapters* was handed down in the 1261 subcommentary by Yang Hui 楊輝 as well as through Dai Zhen's copy from the *Grand Classic of the Yongle period* (see below). For a critical edition, see (Guo Shuchun 郭書春 1990, 491–492). Like the postface to *The Nine Chapters*, the postface to the *Mathematical Canon of the Sea Island* was copied, probably, as Yan Dunjie showed, from the *Grand Classic*, and included in the nineteenth century in the manuscript entitled *Zhujia suanfa ji xuji* 諸家算法及序記 « Mathematical methods and records of prefaces from all schools »; see its reproduction and the introduction in (Guo Shuchun 郭書春 1993, 1: 1451–1452). In addition to the chapter of the *History of the Song* (*Songshi*), already mentioned, the four postfaces provide information on different official positions held by Bao Huanzhi.

commentators. These sources constitute our main evidence documenting how between 1200 and 1213 Bao Huanzhi carried out the reprint of the anthology.

The postface to the *Memoir on the Methods of Numbering* (*Shushu jiyi*) makes clear that, apparently in contrast to the eleventh century project, Bao Huanzhi's project was to restore not only the *Ten Canons*, but in fact the complete set of texts used shortly after the compilation of the *Ten Canons* in the Tang university. This means the *Ten Canons* with their ancient commentaries selected or composed in the seventh century under Li Chunfeng's supervision as well as the two other texts with which officials were trained in the Mathematics College.[12] These facts already clearly demonstrate the impact of various imperial institutions on the way in which the evidence available today for the earliest Chinese mathematical texts that have been handed down was shaped. Indeed, if we summarize the various clues encountered so far, we see that Li Chunfeng's project was commissioned by the Emperor and that its outcome was used in state teaching institutions. Moreover, the 1084 edition and printing of the *Ten Canons* were executed within the Imperial Library. Furthermore, Bao Huanzhi belonged to the circle of civil servants who worked on the reforms of the calendar and aimed to restore the texts once used for the official teaching of mathematics. This conclusion regarding the impact of state institutions on the evidence that has been handed down will appear to hold much more generally in what follows.

It is only in the case of *The Nine Chapters* and its two commentaries that Bao Huanzhi's postface gives some detail on how he was able to find a copy of the collection that he identified with a copy of the eleventh century printing and reproduced.[13] Interestingly enough, the copy was kept by Yang Zhongfu's

[12] (Siu and Volkov 1999). Since the *Memoir on the Methods of Numbering* (*Shushu jiyi*) was one of the two additional books (see footnote 5), its inclusion in Bao's editorial project manifests this intention, which the postface makes explicit. Bao's postface to that book explains that he could not find a copy of the book in the imperial libraries and tells the story of its recovery from the library of a Daoist temple. Moreover, the postface shows Bao's awareness that one canon, the *Zhuishu*, and one auxiliary book, the *Sandengshu*, had been lost. See the reprint of the Song *Shushu jiyi*, (Shanghai tushuguan and Beijing daxue tushuguan 1980, 11a).

[13] Incidentally, this information provides evidence regarding the 1084 edition of *The Nine Chapters* and shows that it consisted of the whole collection. In the surviving copies of Bao Huanzhi's edition of *The Gnomon of the Zhou [dynasty]*, the *Mathematical Canon of the five Bureaus* and the *Mathematical Canon of Master Sun*, the final pages record evidence of the 1084 editorial work done by the imperial administration for publishing these books. The same holds true for the canons for which only copies of that edition made by Mao Yi in the 1680s were handed down: the *Mathematical Canon continuing the Ancients* and the *Mathematical Canon by Xiahou Yang*. These pieces of evidence indicate that, for his enterprise, Bao Huanzhi reproduced a larger part of the 1084 official printing than only *The Nine Chapters*. The final pages of the edition of *The Nine Chapters* and probably of the *Mathematical Canon by Zhang Qiujian* are no longer extant. However, the postface to the *Haidao suanjing*, the southern Song printing of which did not survive, testifies to the fact that Bao Huanzhi did not have access to the Northern Song print of it. The postface explains how Bao Huanzhi assessed the documents he found and how he relied on historical documents to go against the evidence of the manuscripts handed down and ascribe to a book a different author.

family. It was thus within the environment of the state bureaucracy, in relation to his discussions with Yang Zhongfu on the official calendar—a calendar compiled precisely by the Imperial Library (*Bishusheng*) (Winkelman 1974, 19)—that Bao Huanzhi could locate a copy of the collection as printed in 1084 and have access to it. In addition, his report seems to indicate that *The Nine Chapters* and both its commentary and subcommentary circulated as a whole, but not with the entire anthology. We shall mention below further evidence that at the time the collection as such had an existence of its own, independently from the anthology.

Some details Bao gives about his quest for a copy of *The Nine Chapters* are interesting for our purpose. In fact, before finding the copy that he in the end reproduced, he was able to see versions of *The Nine Chapters* that were in private hands. Among the reasons for discarding them that his postface makes explicit, he writes: "None of them had the old commentaries by Liu Hui and Li Chunfeng. The 'meaning/reasoning (*yi*)' of the ancients could no longer be understood, which made (me) constantly sigh with regret." This statement reveals why a reader like Bao Huanzhi valued finding a copy of the collection, and not only of *The Nine Chapters*. Let us stress that the reason adduced relates to the "meaning (*yi*)" of the canon.[14] In addition, the statement discloses motivations at stake for him for printing the entire collection. Such motivations clearly played a crucial part in shaping the collection as it was handed down through the written tradition and in eliminating other editions of *The Nine Chapters* from what was handed down.[15]

This being said, we must keep in mind that, at that time, the reprinting of the collection was still carried out in relation to an edition of the anthology and the other books that in the past had served as textbooks in Tang imperial teaching institutions. As regards editing the other volumes, the postfaces describe how Bao Huanzhi relied on the bibliographical treatises of the dynastic histories of the Sui and the Tang as well as on the catalogue and holdings of the Imperial libraries of the Song dynasty. Even though some copies were to be discovered in private hands or, for the *Shushujiyi*, in a Daoist temple, the catalogues prepared by the governmental institutions were still essential in assessing the copies found and identifying the authors or the commentators. Such evidence highlights from yet another perspective the key part played by the imperial institutions in charge of preserving books and producing bibliographical catalogues for shaping the documents that have been handed down.

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[14] We shall come back to the interpretation of this "meaning (*yi*)" in the subsection III.1 of the chapter. It is interesting that Bao looks for an edition with a commentary and a subcommentary, and not an interpretation authored by a single person.

[15] Bao Huanzhi relied on the bibliographical treatises of the dynastic histories of the Jin and the Tang, as well as on Liu Hui's preface to his own commentary, to establish, in the final section of his postface, why, in his view, the text of the commentaries to which the 1084 edition gave him access had deteriorated through the written transmission.

As far as I can ascertain, Bao Huanzhi's edition, completed in 1213, appears to have been the last edition before the end of the eighteenth century that attempted to keep the anthology of *Ten Canons* as a whole, despite the loss that had already befallen some of its component parts. The two mathematical book printing projects evoked above and carried out in relation to state institutions reflect the emphasis more generally placed during the Song dynasty on "canons" from the past and, in Bao's case, more precisely, on the texts constituting the Tang curriculum. Another clue reveals the importance of canons at the time: new commentaries were composed on the collection of *The Nine Chapters* and its two earlier commentaries. However, note that, to my knowledge, no similar commentary was composed at the time on any other "canon" included in the anthology. The existence of these new commentaries confirms from another angle that the collection on which I focus in this chapter was then perceived as forming a whole: it must be stressed that what was commented upon was *not The Nine Chapters*, but the collection formed by the canon, the commentary selected in the seventh century and the subcommentary written at the time on the two. On the other hand, these Song commentaries do reveal that the collection could be considered independently from the anthology and commented upon separately. Furthermore, these facts indicate that, even if the new editions and printing of the collection were carried out within the framework of projects bearing on all the canons of the anthology as well as the additional textbooks, *The Nine Chapters* with its two traditional commentaries actually received specific, and even the greatest, attention. Such a development constitutes a key step in the formation of our collection, having the internal structuring we described at the beginning of this chapter, and being detached from the context of the anthology within which Li Chunfeng's subcommentary had been once composed. This observation can be derived not only from the facts, but also from the actors' statements.

Of Jia Xian 賈憲's commentary on our collection, probably composed in the first half of the eleventh century and printed by Rong Qi 榮棨 in 1148, we only know what survived in Yang Hui 楊輝's *Detailed explanations of The nine chapters on mathematical methods* (*Xiangjie jiuzhang suanfa*), completed in 1261 and itself a subcommentary based on Jia Xian's.[16] The latter edition hence included the text of the whole collection and, interspersed within its sections, the commentary by Jia Xian and the subcommentary by Yang Hui. Note that the edition of the collection included in Yang Hui's *Detailed explanations* does not depend on Bao Huanzhi's.[17] This fact therefore reveals that

[16] What in Yang Hui's text is to be ascribed to Jia Xian is unclear, as shown by (Guo Shuchun 郭書春 1988). We know almost nothing about Jia Xian's or Rong Qi's biography. As for Yang Hui 楊輝, we have little evidence about him, except the testimony provided by the writings he composed between 1261 and 1275.

[17] Guo Shuchun, in chapter C of (Chemla and Guo Shuchun 2004, 73–74), argues that they share a same prototype. Note that Yang Hui must have known Bao Huanzhi's reprint, since he included in his subcommentary the postface to *The Nine Chapters* (see Footnote 11).

other editions of the entire collection, and not of *The Nine Chapters* alone, were circulating during the Song dynasty, which again confirms, if it were still necessary, the cohesion of its parts for Song actors.

In correlation with their scholarly commitment vis-à-vis canonical literature, Rong Qi, Yang Hui as well as Bao Huanzhi all expressed their belief that *The Nine Chapters* was "the most important of the mathematical canons."[18] This testimony indicates that, even in the eyes of the editor of the whole anthology, Bao Huanzhi, the collection had a privileged status. In the same vein, most of the prefaces to the major extant Chinese mathematical works from this period refer to *The Nine Chapters* and occasionally to its commentators.[19]

To recapitulate our conclusions so far, it appears that until the thirteenth century, the anthology of mathematical canons annotated in the seventh century on imperial order under Li Chunfeng's supervision, and the wider set of texts used in the Tang Imperial University, were the focus of attention of state institutions when they sought to reedit and print or reprint historical mathematical books. As a consequence, the only writings that have been handed down through the written tradition were those that were, in fact, selected within this sequence of official enterprises. This sheds some light on the processes that shaped the oldest extant edition of the collection as well as the anthology, that is, Bao Huanzhi's printing of the Tang textbooks. On the other hand, we see

[18] Rong Qi's preface states: "When the government instituted the examinations in mathematics to select officials, they chose *The Nine Chapters* to be the foremost (literally, the head) of the mathematical canons, since, indeed, it is like the six canons of the Confucians, the (*Canon of) difficulties* and the *(Grand) Simplicity* of the medical schools, the *Book of Master Sun* of military schools! 以國家嘗設算科取士選 九章,以為算經之首, 蓋猶儒者之六經, 醫家之`難', `素', 兵家之`孫子' 歟 ! " (The preface was reproduced in Yang Hui's *Detailed explanations,* who also quoted this passage in one of his own prefaces in the book. Critical editions of these texts can be found in (Guo Shuchun 郭書春 1990, 489, 495).) Likewise, in his 1200 postface to the collection, Bao Huanzhi claims that "Among the books of mathematical procedures, there are altogether ten schools. *One can only consider* The Nine Chapters *as being the foremost of the canons. With the methods of its nine parts of mathematics* (*jiu shu*), there is *nothing which is not complete*. Although the *procedures* established by the various schools *present variation, when one looks for the original meaning* (*yi*)*, they all come from them"* (My emphasis, (Guo Shuchun 郭書春 1990, 491).) Note the use here of the term "meaning (*yi*)." This term is the same one as the one we saw Bao Huanzhi use to express the reason of his interest in the commentaries on *The Nine Chapters*: they highlighted in his view the *yi* of the canon. Both statements imply that for Bao Huanzhi, the reader looks for the "meaning (*yi*)" of the canons and that this search is made easier, in the case of *The Nine Chapters*, if one can rely on the commentaries. Moreover, inquiring into the *yi* of the other canons shows why *The Nine Chapters* has in fact a higher status. These facts, which are essential to capture the kind of reading actors made of the collection as such, incite us to expect a relation between the content of the commentaries and the special status enjoyed by *The Nine Chapters* within the anthology.

[19] See, for example, the prefaces to the *Mathematical writings in nine chapters* (1247), by Qin Jiushao, *Deploying the pieces for the* [Collection] augmenting the ancient (methods) (1259), by Li Ye (Guo Shuchun 郭書春 1993, 1: 439, 875), and the prefaces to *Jade mirror of the four origins* (1303) by Zhu Shijie (Guo Shuchun 郭書春 1993, 1205–1206).

how within this context, the various actors imparted both cohesion, and autonomy from the whole, to the collection composed by *The Nine Chapters*, Liu Hui's commentary and Li Chunfeng's subcommentary. Whether we observe the way in which in the Song dynasty, copies of *The Nine Chapters* circulated, the constraints under which copies were sought or the conditions under which the canon was commented upon, it is clear that in the actors' eyes, only the collection as such was meaningful, and none of its components alone.

The First Imperially Commissioned Encyclopedia of the Ming Dynasty

The second line of textual evidence from which we draw our knowledge of historical mathematical texts derives from the *Grand Classic of the Yongle period*—hereafter: *Grand Classic*—, an editorial project commissioned by the Emperor Yongle (reign dates: 1403—1425) and carried out between 1403 and 1408. The purpose ascribed to the work, which drew on the tradition of "Classified writings," was to extract and rearrange thematically the contents of the books deemed worthy of recording among all the writings produced in China's past. What matters for us here are two key facts. First, the only books written until the seventh century that were included in the *Grand Classic* were canons, though not all of the *Ten Canons*.[20] Secondly, to follow up our inquiry into the historical shaping of the collection under study, the way in which mathematical writings were included in this compilation provides other clues showing that by contrast to the *Ten Canons*, the components of which were not always handed down together, the collection of *The Nine Chapters* and its two key commentaries had achieved a stronger cohesion. The two extant chapters dealing with mathematics (16343 and 16344) that escaped the destruction that affected the greater part of the *Grand Classic* in the nineteenth century show how the selected books were integrated into this opus magnum. The mathematical writings were divided into sections devoted to distinct mathematical topics, and these pieces were thereafter presented thematically. For instance, chapter 16344 is devoted to the themes covered by chapter 4 of *The Nine Chapters*, entitled "Small width." Chapter 4 of the canon dealt successively with five topics (small width, extraction of the square root, of the circular root, of the cube root and of the spherical root). Chapter 16344 follows this scheme in five parts, to present, for each topic, the related sections selected from a number of mathematical books, the earliest one being *The Nine Chapters* and the most recent ones having been composed only few decades before the compilation of the *Grand Classic*. Each excerpt is introduced by the title of the book, the inscription of which generally starts in the upper margin. Three points are important for us here to note.

[20] The *Zhang Qiujian suanjing* and the *Jigu suanjing* were not contained in it, nor was the *Shushu jiyi*, see tables 1 and 3 in (Chu Pingyi (Zhu Pingyi) 2010).

First, each excerpt in *The Nine Chapters* contained the text of the canon as well as that of Liu Hui's commentary and Li Chunfeng's subcommentary. The canon appears to have been entirely included in the *Grand Classic* in this way, which to our knowledge constituted its first reedition since the Southern Song publications discussed above. Note that the document on which the edition contained in the *Grand Classic* was based for *The Nine Chapters* and its key commentaries did not depend on the two Southern Song editions discussed above, which yields yet another testimony concerning the circulation of the collection as such.[21] Secondly, the Song subcommentary by Yang Hui, *Detailed explanations of The nine chapters on mathematical methods*, was included too, but as a separate book. Since this book contained the text of the collection, this implies that two editions of *The Nine Chapters* with Liu Hui's and Li Chunfeng's commentaries were included in the *Grand Classic*: one under the title *Mathematical Canon of The Nine Chapters*, and a second, with Jia Xian's and Yang Hui's subcommentaries under the title *Detailed explanations on mathematical methods*.[22] If all these facts clearly display the cohesion of our collection, the second remark also shows that the Song commentaries were not considered as adhering to the collection in the same way as the early commentaries did. Lastly, in the *Grand Classic* the anthology of *Ten Canons* was not given any particular emphasis in the presentation. In conclusion, the composition of the *Grand Classic* bears witness to the fact that the collection of *The Nine Chapters* and its two then traditional commentaries was considered as presenting a strong cohesion and forming an independent whole. By contrast, the Tang anthology does not seem to have received any particular attention as such in the compilation. Yet its impact on the written tradition can be felt through the selection of historical texts that could then be included in the *Grand Classic*.

The Complete Libraries*, Another Imperially Commissioned Encyclopedia From the Eighteenth Century*

It was not until the end of the eighteenth century, as an outcome of the research carried out for another gigantic imperially commissioned encyclopaedic project, that an attempt was made to restore the anthology as such.[23] Such an attempt required, as a precondition, the recovery of the texts of the books composing it.

[21] See Guo Shuchun, Chapter C, in (Chemla and Guo Shuchun 2004, 72–73).

[22] One should take also into consideration the excerpts contained in Yang Hui's final chapter, "Compiling the Categories of *The Nine Chapters* (*Jiuzhang zuanlei*). However, I shall leave these details out here.

[23] In what follows, regarding the *Ten Canons*, I rely on (Chu Pingyi (Zhu Pingyi) 2010), Chapter C by Guo Shuchun in (Chemla and Guo Shuchun 2004, 74–79) as well as the introduction to (Guo Shuchun 郭書春 and Liu Dun 劉鈍 1998). Moreover, for the various editions of the collection published by Dai Zhen, see Chapter C, by Guo Shuchun, in (Chemla and Guo Shuchun 2004).

Indeed, by the time the project of the *Complete Libraries of the Four Treasuries* (*Siku quanshu* 四庫全書) was launched, in 1773, *The Nine Chapters* and its key commentaries, as a separate collection, were no longer available for those interested in them.[24] Is it because in the previous centuries books had been compiled that covered the "nine chapters" and for this reason replaced the canon in its uses? Is it in relation to the introduction of mathematics from Europe through Jesuit missionaries? It is hard to tell precisely. Whatever the case may be, the scholar appointed to the commission in charge of the *Complete Libraries* to select and edit historical Chinese mathematical and astronomical books for the encyclopaedic work, Dai Zhen (1724–1777), could rely only on the excerpts scattered in the various sections of the *Grand Classic* to retrieve *The Nine Chapters*, and he restored the book in the form of a collection grouping the canon and its two commentaries. This fact reveals the persistence of the view that *The Nine Chapters* was in fact to be understood as corresponding to the collection of the canon and the commentaries.[25] But it also highlights the key role played by the Ming Imperial encyclopaedia for preserving historical mathematical texts.

It is interesting to analyze how Dai Zhen proceeded to restore the collection. In fact, as we see above, there were two editions of the collection included in the *Grand Classic*. One was the edition of the collection as such, whereas the other one was the edition contained within Yang Hui's *Detailed explanations*. Since the greater part of the *Grand Classic* disappeared in the nineteenth century, it is only on the basis of chapters 16343 and 16344 that we can probe into Dai Zhen's mode of editing. Analysis shows that he compared the two editions, since, even though he mainly followed the text of *Mathematical Canon of The Nine Chapters*, in places, without mentioning it, he included in his copy readings from the edition of the *Detailed explanations*.[26] So he strove to restore *The Nine Chapters* with its two key commentaries on the basis of all the source material available in the *Grand Classic*. However, Jia Xian's and Yang Hui's subcommentaries were

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[24] In his postface to the printing of one of his editions of *The Nine Chapters* by Qu Zengfa 屈曾發 in 1776 (see (Guo Shuchun 郭書春 1990, 503)), Dai Zhen recalls how he had been looking for a copy of *The Nine Chapters* for twenty years when in 1767 he managed to have access to the text, in the edition of the *Grand Classic*. The passage is recorded with differences in (Duan Yucai 1980, 228–229). Moreover, it is quoted in (Guy 1987, 62). However, in my view, the translation is not completely accurate. The reader will find in this book a general introduction to the project of the *Complete libraries*.

[25] If this fact manifests Dai Zhen's perception of the collection as a cohesive whole, by contrast the *Complete Libraries* did not place emphasis on the cohesiveness of the anthology. Even though the notice on the collection in the "General catalogue" of the *Complete Libraries* mentioned its belonging to the "*Ten Canons of Mathematics,"*—it was restated to be "the foremost of the *Ten Canons of Mathematics* 为《算经十书》之首"—, the corresponding mention was by no means systematically made for the other components of the Tang anthology; see (Ji Yun, Lu Xixiong and Sun Shiyi 1997, 1: 1386–1387, 1401–1405) for the relevant notices.

[26] I examined the point on the basis of the first part of chapter 4 ("small width"). See footnotes 4, 8, 11, 14, in (Chemla and Guo Shuchun 2004, 342–344).

not copied from the *Grand Classic* for inclusion in the *Complete libraries*. In correlation with this choice, these subcommentaries have survived only partially, in the edition published by Song Jingchang in 1842 within the framework of the *Yijiatang conshu* 宜稼堂叢書 series and based on an incomplete copy of the book kept by Yu Songnian's family. These remarks reveal the importance for the survival of a book that it be included in *both* the imperially commissioned projects of the *Grand Classic* and the *Complete Libraries*. From another perspective, the collection of evidence recalled above is significant for us, since it sheds further light on the compilers' perception vis-à-vis the collection, with its two commentaries. By contrast to the cohesion that, in their eyes, clearly characterized the collection, they did not consider the Song subcommentaries as adhering to it as one of its integral parts. We hence find, continuously reasserted, the cohesion and autonomy of the same collection of writings. Moreover, contrary to the attitude demonstrated by the compilers of the *Grand Classic*, those of the *Complete Libraries* did not deem the Song commentaries even worthy of inclusion.

There is evidence that a fragmentary copy of Bao Huanzhi's 1213 edition of the collection could still be read in the seventeenth century.[27] However, Dai Zhen completed his edition, for the *Complete Libraries*, of the collection shaped through history around *The Nine Chapters*, before seeing it. A first version of Dai Zhen's edition was printed in 1774 among the texts selected for the *Complete Libraries* for *Impression of the Assembled Gems from the Palace Wuying* (*Wuying-dian juzhenban*). Only after that publication could Dai Zhen use the copy of the Song woodblock print of *The Nine Chapters* and its two key commentaries. He relied on it to continue editing the text of the collection further. In 1776, Dai Zhen had this new edition printed, now as an independent volume—together with the edition of the *Mathematical Canon of the Sea Island*, which Liu Hui had composed to restore a lost part of *The Nine Chapters*. So, for the first time since Song times, as far as we know, the collection was published again and circulated as such.

Within the framework of the *Complete Libraries,* Dai Zhen had carried out similar editorial work for each of the ancient mathematical books for which he could find evidence, thereby restoring what proved to be most of the *Ten Canons* and one of the additional textbooks used in the Tang University.[28]

[27] The extant copy contained the first five chapters of *The Nine Chapters* with its commentaries as well as some of the other canons. We know, for instance, that Mei Wending had access to it, thanks to Huang Yuji 黃虞稷. I thank Catherine Jami for having provided me with evidence from Mei's book *Wu'an lisuan shuji* 勿庵曆算書記 (*Siku quanshu*, p. 50a) that Mei mainly saw the first chapter of the Southern Song reprint.

[28] In addition to *The Nine Chapters*, Dai Zhen included in the *Complete Libraries* six other of the *Ten Canons* on the basis of the edition of the *Grand Classic*. The remaining two canons (*Mathematical Canon by Zhang Qiujian* and *Mathematical Canon Continuing the Ancients*) as well as the *Memoir on the Methods of Numbering*, which had not been copied in the *Grand Classic*, were included in the *Complete Libraries* thanks to copies found otherwise through the book search done in the Empire in relation to the compilation of the new imperial project. Reproductions of the southern Song reprint played a key part in this. However, in his editorial work, Dai Zhen sometimes used more than one edition, see the introduction of (Guo Shuchun

However, in the *Complete Libraries*, no emphasis was placed on the anthology, its various components being divided up into two sets that were the foundations of, respectively, mathematics and astronomy. Eight books that had belonged to the *Ten Canons,* as well as the *Memoir on the Methods of Numbering*, made up the first books to be included in the "mathematics" section of the *Complete Libraries—The Nine Chapters* coming first—. The other remaining canon, *The Gnomon of the Zhou [Dynasty]* (*Zhoubi*), was placed at the beginning of the astronomy section. It was only afterwards that Dai Zhen worked on a separate edition of the *Ten Canons*, in which the *Shushu jiyi* was included at the end. In this further reworked version of Dai Zhen's critical edition, which Kong Jihan 孔繼涵 (1739–1783) printed in 1777 under the title *Ten Canons of mathematics* (*Suanjing shishu* 算經十書), the anthology was restored to its integrity and its autonomy. [29] This version of the *Ten Canons* is the first known reprint of the Tang anthology—including the *Memoir on the Methods of Numbering* published at the end—since Bao Huanzhi's edition in the Song dynasty, which had inspired its publication.

Kong Jihan's woodblock print was the main basis for all subsequent editions of the anthology in China. We thus see in which sense the project of the *Complete Libraries* has in fact been the main vector shaping the way in which, in the nineteenth and twentieth centuries, mathematical writings produced in China prior to the seventh century and handed down to us through the written tradition were available. From Kong Jihan's publication onwards, the ancient textual traditions were revived and made available on a large scale—a fact that cannot be underestimated. Moreover, the actual Chinese books displaying the text of the *Ten Canons* that have been the most easily available since then all derive from this editorial enterprise. To sum up, the analysis just outlined again reveals the impact of choices made in the seventh century on the shaping of historical literature carried out in the *Complete Libraries* and the editorial enterprises deriving from it, with respect to mathematics and in fact astronomy as well.

More generally, the argumentation developed above leads us to two conclusions important for our purpose.

Firstly, if we analyze what has come down to us from early China through the written tradition, it appears that no mathematical writing composed before the Tang dynasty has been handed down, had it not been

郭書春 and Liu Dun 劉鈍 1998). The mathematical writings selected for inclusion in the prestigious *Impression of the Assembled Gems from the Palace Wuying* followed another principle of selection: they were only those of the *Ten Canons* that could be copied from the *Grand Classic*. See table 2, in (Chu Pingyi (Zhu Pingyi) 2010).

[29] On the dating of the publication, see note 3 in (Guo Shuchun 郭書春 1990, 506). Mikami Yoshio gives a short biography for Kong Jihan and describes the impact of the publication in (Mikami Yoshio 1913, 122–123). In his book, Mikami clearly relies on Dai Zhen's historical work carried out in relation to the latter's involvement in the *Complete Libraries*. This is one of the manifold manifestations of how Dai Zhen's work in relation to the compilation of the *Complete Libraries* shaped the subsequent historiography.

continuously selected through the projects that were imperially commissioned during the Tang, the Song, the Ming and the Qing dynasties—I shall not repeat here the nuances that were introduced above. Given the recurring emphasis placed during the Tang and Song dynasties on the *Ten Canons* and the additional textbooks used in the Tang University, only books selected within these two contexts—or books mistaken for them—had a chance of being passed down. This conclusion highlights the impact of the imperial institution on the shaping of sources available to the historian through the written tradition.

In this respect, the beginning of large-scale funerary archeology in the last century, dramatically changed this state of affairs, by reintroducing to our sources writings selected through other processes. It reveals a contrast. The mathematical writings that survived through the former channel were all granted the status of “canons” in the Tang dynasty at the latest or were used along with other canons in the Tang University. In correlation, they were all the object of commentaries. Neither the *Xiahou Yang suanjing*—which was erroneously substituted for a lost book during the Song dynasty—nor the mathematical sources brought to light by archeologists—whether from Han tombs or from the Dunhuang cave sealed in Central Asia around the year 1000—display either of these two features.

Secondly, as regards now more specifically *The Nine Chapters*, it was through such a historical process that the collection of the canon and its two commentaries was shaped as such and has been handed down to us today. The fact that, had the Song commentaries been copied from the *Grand Classic* to be included in the *Complete Libraries*, they would probably have survived to this day is quite revealing in this respect. The contrast also shows that for all the actors of whom we know and who in history edited, or commented upon, *The Nine Chapters*, the collection, with its internal structuring that opposed a canon to both the ancient commentary and subcommentary, had a strong cohesion, which the Song subcommentary never equalled. In addition to this cohesion, the collection soon gained its autonomy from the context of the Tang subcommentary on the *Ten Canons*, within which it was formed. This is why the collection circulated, and was commented upon, independently, without being dissociated.

We understand now the unfolding of that process which is responsible for there not being today any editions of either *The Nine Chapters* or its two traditional commentaries that would not contain the entire collection. Or, to put it in other terms, we understand how the written tradition bequeathed us the collection as such. This is correlated to the fact that throughout history our actors’ actions and statements testified to their perception that it was the collection as a whole that was meaningful. However, despite the unremitting reassertion in the past of the import of the collection as such, I shall now explain why, in my view, it has hardly ever been approached as such in the historiography of the nineteenth and the twentieth century.

A Historiographical Sketch of the Approach to *The Nine Chapters*

Instead of developing an exhaustive historical analysis of how in the last two centuries historiography has dealt with *The Nine Chapters* and the two commentaries handed down with the text of the canon—a task in any case impossible to fulfill within the framework of a chapter—, this section attempts at delineating a periodization for how the collection was dealt with in nineteenth and twentieth century historiography. Accordingly, I shall illustrate the various stages I distinguish in the treatment of our topic by snapshots taken from historical publications. I hope that future research will contribute to refine or even correct the historiographical sketch outlined here.

Translations of the Collection into Modern Languages

Observing the history of the translations of *The Nine Chapters* and its traditional commentaries—or lack thereof—into modern languages yields interesting insights into the change of focus that characterized historians' interest vis-à-vis the collection in the last two centuries. Translations into Western languages, from the first, in 1957, until 1999, only address *The Nine Chapters*, without including the text of any of the commentaries.[30] In some sense, the translators adopted the same attitude as the first sinologist who translated one of the *Ten Canons*: the French scholar Edouard Biot.[31] When Edouard Biot published his translation of *The Gnomon of the Zhou* in the *Journal Asiatique* in 1841, he mentioned the existence of commentaries attached to it—commentaries that adhered to the canon in the same way as what is recounted above for our collection. Biot regularly refers to them in his own notes, in particular to support his interpretation of the canon. However, he did not translate them systematically (Martija-Ochoa 2002, 45–46). The same held true when Van Hée translated the *Mathematical Canon of the sea island*, originally written as Liu Hui's restoration of a part of the canon, but detached from it and turned into an independent text in the seventh century. Van Hée leaves aside the commentary composed by Li Chunfeng, except for the last problem, which for no obvious reason Van Hée paraphrases.[32] These translations somehow bear witness

[30] The first translation of *The Nine Chapters* was carried out into Russian in the 1950s: (Biérëzkina 1957). It served as a basis for the German translation: (Vogel 1968).

[31] For a sketch of his biography and an analysis of his translation, see (Martija-Ochoa 2002).

[32] (Van Hée 1933, 269–282). The doubts Van Hée casts on the authenticity of the text are formulated in a disparaging tone that permeates through the whole paper. Interestingly, Van Hée complements his translation of each of Liu Hui's problems and procedures, with the details of the operations taken from Li Huang's 1820 commentary. The same canon was translated into English: (Swetz 1992). The author translates the statement of the problems and the procedures provided afterwards and solving them. However, Swetz explained (p. 19), "Li Chunfeng's commentary is omitted because it does not aid in understanding the rationale of Liu Hui's solution methods." The question remains open to understand why the text has been handed down in that way.

to the perception that the treatises stood on their own and represented what was most important.

The first modern scholar to break, in some sense, with this custom was the translator of Liu Hui's commentary into Japanese: Kawahara Hideki.[33] As is clear from the title of his translation, his focus is Liu Hui's commentary and accordingly he translates *The Nine Chapters* with its oldest extant commentary. However, even though Kawahara mentions Li Chunfeng's commentary in his own footnotes, he opts to leave the subcommentary un-translated. The next section will make clear why in the context of the time, this choice was meaningful. However, in doing so, Kawahara too does not provide his readers with the collection as it had taken shape over time and had been used by its readers in China for centuries.[34] But there is more to it: I would suggest that this incomplete rendering of the collection raises a fundamental problem. As early as 1200, Bao Huanzhi's postface to *The Nine Chapters* bears witness to the fact that there were doubts regarding the transmission of Li Chunfeng's commentary. Bao notices that the text of chapters 7 and 8 contained no commentary ascribed to Li Chunfeng, which contradicts the historical evidence about it he was aware of. Today, one is entitled to wonder whether Liu Hui's and Li Chunfeng's commentaries for these chapters were not merged into a single text. Similar doubts have been formulated by several scholars in recent decades, and they have become increasingly acute and wide-ranging. This gives a strong incentive to keep the collection in the form in which readers have had it at least from Song times onwards.[35]

It was only in 1999 that the collection as such, that is, the set of texts that actors shaped in history into a cohesive whole, was rendered into a foreign language, with the translation into English published by Shen Kangshen, J. Crossley and A. Lun.[36] It is interesting, though, that in the layout of the pages, the arrangement of the collection shared by all extant ancient sources is

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[33] (Hideki Kawahara 1980).

[34] The same attitude can be met in the most recent critical edition of the *Ten Canons*: (Guo Shuchun 郭書春 and Liu Dun 劉鈍 1998). Zhen Luan's level being judged as low and his errors multiple (see introduction), his commentary on *The Gnomon of the Zhou*, as well as Li Chunfeng's subcommentary on it, were deleted from the edition (p. 34).

[35] (Wagner 1978). My introduction to chapter 6 in (Chemla and Guo Shuchun 2004, 472–473) summarizes my conclusions on this topic and provides a more detailed and recent bibliography. I cannot, within the context of this chapter, tackle this issue any further. Suffice it to notice that part of what has been done on a commentary that was thought to be Liu Hui's may have in the future to be reconsidered in this perspective. If, as we shall see, in recent decades, Liu Hui has attracted the greatest attention, this may be a consequence of editorial problems that will need to be addressed anew in the future. Let us for now keep in mind that this name may refer to a complex historical reality and concentrate in what follows on "commentaries," without stressing too much who their author may be. This has, however, a consequence for our project: we can raise questions concerning the relationship between the canon and its commentaries, taken together. But we will not be in a position to discuss accurately the difference in kind between Liu Hui's commentary and Li Chunfeng's subcommentary.

[36] (Shen Kangshen, Crossley and Lun 1999).

modified. Instead of interspersing the commentary and the subcommentary between the paragraphs or sentences of the canon, as is shown in all ancient Chinese editions, in this translation *The Nine Chapters* is presented as a text of its own, and Liu Hui's commentary, Li Chunfeng's subcommentary as well as the translator's notes are introduced as footnotes to the main text. The difference between the type font used for the entries allows the reader to understand the nature of what is to be found in the related footnotes. It is interesting for our purpose that the English translation of the collection thereby shows the commentaries as being "footnotes" to the main text, parallel to the modern translator's footnotes. One may wonder if the character of Li Chunfeng's annotations to be a subcommentary is not lost in such a presentation. In any event, this layout faithfully reproduces that of the translation in modern Chinese by Shen Kangshen (Shen Kangshen 沈康身 1997), on which it was based.

This earlier translation belongs to a new trend in publications on Chinese history, which for *The Nine Chapters* developed from 1982 onwards, with Bai Shangshu's publication of a first volume of annotations and then a translation of the whole collection into modern Chinese (Bai Shangshu 白尚恕 1982, 1990). In its wake, no less than three other translations into modern Chinese appeared in the subsequent two decades. By contrast with Shen Kangshen's, the others, which also address the entire collection as such, translated its text as displayed in all the ancient editions. Interestingly enough, despite occasional studies, no other canon was the object of a similar attention. Again, the importance of *The Nine Chapters* in comparison with all the other canons is reasserted. By contrast, only two research programs concentrated on the whole anthology: the publications by E. Berioskina until the 1980s[37] and the Ph. D. thesis by Robert Schrimpf, which yields a translation of the statements of all its problems (Schrimpf 1963, 391–520).[38]

Historical Studies: A First Phase

If we now turn to historiography proper and examine how historical studies have approached the collection in the last few centuries, we discover that historians' emphasis has followed a pattern similar to that illustrated by the translations into modern languages.

My first claim is that although, as we see in the previous sections, the text of the collection was easily available from at least the end of the eighteenth century, until the end of the 1950s, the historical studies inside or outside

[37] See the reference and analysis in (Youschkévitch 1982).

[38] Although Schrimpf's focus was the anthology, he emphasized those canons and commentaries —or the parts in them— that consisted of problems and algorithms. His thesis, rooted in sinology, aimed at restoring conceptual specificities of the mathematics expounded in the anthology, translating or describing its content in three parts (arithmetic, geometry, algebra). I shall come back to it in a publication on the historiography of the anthology.

China focused on *The Nine Chapters,* that is, the main text, essentially disregarding the commentaries.

The first substantial bibliographic presentation of Chinese mathematical literature available in Western languages was published by the protestant missionary Alexander Wylie in 1867. Quite interestingly, his account of the various mathematical books produced in China before the seventh century seems to depend to a great extent on the organization of the *Complete Libraries* (Wylie [1867] 1964, 106–107, 113–116). This clue shows that the influence of the gigantic encyclopaedia published in China at the end of the eighteenth century on historiography could be felt from quite early on beyond the borders of China. Among other facts, in this publication Wylie manifests his awareness of the existence of commentaries by Liu Hui and Li Chunfeng which were handed down with *The Nine Chapters*. However he adds nothing on their content. However, he mentions Liu Hui as the author of another book: the *Mathematical Canon of the sea island*. Some fifteen years earlier, when Wylie published a set of papers, the "Jottings on the Science of the Chinese,"[39] that would circulate widely in Europe and introduce for the first time basic information on the history of mathematics in China, he mentions Liu Hui for yet another reason, but without mentioning him as a commentator: he attributes to him the fact of having given 157 to 50 for the ratio of the circumference to the diameter of the circle.

These are the features typical of most accounts of the commentaries in the first period of our periodization. On the one hand, Liu Hui is dealt with as the author of a book proper. On the other hand, when his commentary is evoked, it is seldom mentioned or used *as* a commentary. It is rather considered as another text of its own, and isolated "achievements" are "extracted" from it. The earliest and main example of such "achievements" are, as is the case here, the values Liu Hui obtained for π. Later, other elements would be added to them, such as "new procedures."

By contrast, and again characteristically for the period I attempt to define here, the "Jottings" devote relatively much more space to describing the contents of *The Nine Chapters* (pp. 177–180), whose "results" Wylie faithfully summarizes. Probably in reaction to the way in which mathematical knowledge was presented in most Chinese books as in *The Nine Chapters*, that is, in the form of particular problems followed by "rules" for solving them, Wylie states: "Some questions in modern science have received a *practical illustration* in the ordinary habits of the 'Flowery' race, and some few have been constrained to admit, that they have for time out of mind, possessed a *perfect knowledge of facts*, which have been *but recently arrived at through the medium of theory in the West"* (p. 169, my emphasis). In other words, Wylie acknowledges that "the Chinese" (the "flowery race") had a "perfect knowledge of facts" that came to be known only afterwards in the West. However, he opposes the access to these

39 (Wylie [1852] 1882).

facts in the East and West: the practical turn of mind of the former is opposed to the theoretical method by which the same results were obtained in the West.

A few pages later, Wylie explains his way of approaching and understanding the texts: "It is by no means an easy task to arrive at the exact meaning of most of the books here mentioned, (...); *few general principles* are given, but they are *left to be deduced from a variety of examples,* and these for the chief part are stated with *most perplexing brevity* (...) a separate rule is generally given for every problem, but a careful analysis of the various examples will enable the student to gain an insight into the principles they illustrate" (p. 175, my emphasis). We can observe that despite the difficulties in interpreting the texts he reports on, he does not seem to seek help in the commentaries. Moreover, he makes explicit his intuition that the "examples" lead to "general principles." However, for him, the reader only "gain[s] an insight" but, in his view, the text does not engage further into theoretical matters. What matters for me here is that he describes the way in which a reader made sense of the text and what the reader derives from the text without referring to the commentaries as providing evidence against which to test these conclusions. Again, several of his assessments contain *topoi* that were to be regularly taken up by subsequent historiography of the mathematics in ancient China. To summarize the characteristic features of the approach, in addition to an emphasis on, on the one hand, "achievements" and, on the other hand, "main texts," that is, here, *The Nine Chapters*, the interpretation of the text derives from a spontaneous reading, without the help of commentaries. Accordingly, the text is stated to be difficult to understand and the burden of reaching theoretical statements left to the reader.

In the same vein, Liu Hui's biography that Ho Peng Yoke composed for the *Dictionary of Scientific Biography* in 1973, and which relies on most of the previous publications on the topic, can be taken as representative of the first period I attempt to characterize (Ho Peng Yoke 1973). Besides a history of the various editions of the collection, Liu Hui's biography turns out to be a description of the main results contained in *The Nine Chapters*. In other terms, the commentator is overshadowed by the text commented upon, which Ho Peng Yoke considers to be "intended as a practical handbook." Accounting accordingly for the nature of the problems making up the canon, Ho sees them as reflecting the concrete uses to which the readers would put *The Nine Chapters*. As regards Liu Hui proper, the biography mentions two facts concerning his commentary: Liu Hui's way of calculating a new value of π and the explanations he provides for positive and negative numbers. Furthermore, the biography outlines the main contents of the *Mathematical Canon of the Sea Island*. We recognize the main historiographic features outlined above.

If we examine the references that Ho Peng Yoke provides in his bibliography, we can see that when (Mikami Yoshio 1913) in Japan, (Needham and Wang Ling 1959) in Cambridge (UK), (Juschkewitsch (Youschkevith) 1964) in USSR or (Vogel 1968) in Germany, mention Liu Hui, they similarly mainly stress some of his "achievements," extracting facts from a writing seemingly composed by an author who simply lived after *The Nine Chapters* was compiled. Moreover,

among these historians, Mikami, (Needham and Wang Ling 1959) as well as Vogel insist on the practical orientation of *The Nine Chapters* and Liu Hui's geometry, and on the empirical nature of the discipline of ancient China, a conclusion which Ho Peng Yoke endorses. By contrast, Juschkewitsch captures, in the algorithms of *The Nine Chapters*, a theoretical orientation, by diagnosing a strong interest in the greatest generality possible for the procedures. In this respect, he agrees with Wylie's earlier statements on the generality meant by the statement of the "rules" as well as with the thesis which Wang Ling had completed few years earlier: (Wang Ling 1956).[40]

In correlation with this conviction, both Juschkewitsch and Wang Ling regularly attempt to restore the reasoning from which, in their view, the algorithms contained in *The Nine Chapters* certainly derive. Characteristically, Wang Ling states: "Although all the logical steps were usually not recorded in the text, and there was no habit of preserving proof, yet the *process* through which the rule or the formulae is arrived at is *itself a proof. Unlike the carpenter* who feels it to be numerically true and considers it as a part of his practice and experience, Chinese mathematicians recognized it as a *general theory*, and *expressed it in general terms* and words" (My emphasis (Wang Ling 1956, vol. 1, 295)). According to the cases, Juschkewitsch's reconstructions chime with Liu Hui's commentary or diverge from it. However, his lack of knowledge of Chinese language probably prevented him from being aware of the fact. Nor did he, in the early period of his research on the mathematics of ancient China, manifest any interest in using the commentaries for any purpose. By contrast, Wang Ling regularly sought help in the commentaries, either for interpreting a term or precisely to assess the validity of his reconstitution of a reasoning.[41] If he betrays an acute awareness of the existence of commentaries, we may however notice that Wang Ling considered himself as a commentator among other commentators and, in the end, sought to attribute the restored reasoning to the authors of *The Nine Chapters*. In other words, for him, in his commentary, Liu Hui is simply making explicit what the authors of the canon had not recorded.

In conclusion, whether historians mainly speak of *The Nine Chapters* or attribute to the canon developments found in the commentaries, they all concretely and implicitly agree on the fact that the main emphasis should be placed on the main text. Moreover, when they indicate an achievement due to the commentator, the commentary is considered simply as another text subsequent to *The Nine Chapters*. In other words, until the end of the 1950 s and the beginning of the1960s the reading

[40] It should be stressed that the scholars just mentioned come from backgrounds that are dramatically different and from quite distinct places of the planet.

[41] Typically, he would write: "We, therefore, believe that our analysis may represent the original thought-process of the author. This conjecture is confirmed by the commentary of Liu Hui (third century A.D.) who remarked that it is actually a case of the rule of proportion, *Chin Yu Shu*" (that is, *jinyou shu*, the procedure of "Suppose," which is the rule of three), see (Wang Ling 1956, 182). It is interesting to note that, except marginally, such an approach does not seem to have had a strong impact on (Needham and Wang Ling 1959).

of the collection concentrate on *The Nine Chapters* whereas commentaries are for their most part overlooked. One is tempted to attribute this fact to the genre to which these latter texts belong and which may have been commonly considered as a minor one. Although the question would require further research, the hypothesis is supported by evidence an actor of the time provides regarding how the various components of the collection were perceived. This piece of evidence comes from a passage of Wang Ling's thesis in which he wonders why his interpretation that Liu Hui's commentary introduces "decimal numbers" had not happened earlier. The reason Wang Ling adduces for this is revealing for us, since he writes: "*this appears only in his commentaries, and he* [Liu Hui] *did not embody it in an influential text*," (My emphasis (Wang Ling 1956, 281)). This remark allows us to understand how a historian in the 1950s could sense the various genres of text and their distinctive impact on historiography. Although in his view Liu Hui has contributed an innovation, Wang Ling feels that it had been overlooked due to its "only" being published in a commentary.

I would suggest the hypothesis that the attention paid to the distinct components of the collection was biased by a translation of their textual categories into modern categories and a subsequent emphasis placed on those parts thought more meaningful. For the issue under discussion in this chapter, this would mean that the collection as it had been shaped by the actors was hence not approached as such.

Post-1949 Historiography of Ancient Mathematics

In contrast to some of the historians evoked above, for whom the achievements found in the canon had been obtained empirically and in any case without theoretical background, Wang Ling in his thesis and Youschkévitch decidedly opt for the assumption that they had been derived through reasoning. The question of proof is raised and in fact it echoes a shift that had occurred in China at roughly the same time and which marks the beginning of the second period in my periodization.

If Wang Ling turns his attention to the commentaries to find support for his reconstruction of the reasoning behind the procedures of the canon, it implies that the commentaries themselves contain similar reasoning that account for the correctness of the procedures given in *The Nine Chapters*. At the end of the 1950s and the beginning of the 1960 s, in China the works of Li Yan and Qian Baocong testify to the fact that this feature had clearly started to capture an increasing amount of attention from the historians. In correlation to this development, we witness a change in the approach to the collection: an emphasis that quickly grew in intensity was placed on the proofs and accordingly the focus of attention on the collection shifted from the canon towards the commentaries.

When, for instance, in 1958, in the *Revised edition* of *An Outline of Chinese Mathematics*, Li Yan deals with the mathematical content of the collection, he devotes less space to *The Nine Chapters* (Li Yan 李儼 1958, 26–27) than to Liu

Hui's commentary (Li Yan 李儼 1958, 40–54). Moreover, besides mentioning "achievements" such as the way of calculating a value for π, Li Yan describes the "definitions" introduced by Liu Hui (p. 41), the "theorems" he knew (p. 43, 54) and the "proofs" with which Liu Hui established the correctness of the algorithms (formulas in his terms) for determining the volumes of solids (Li Yan 李儼 1958, 54).[42] A few years later, the history of mathematics in China composed by Li Yan and Du Shiran attests to the fact that the theme of proof was gaining momentum in the historical studies, and accordingly Liu Hui's commentary is taken into account more and more. It states: "We know that *The Nine Chapters on mathematical procedures* only listed general algorithms, but very seldom gave any explanation or clarification. Liu Hui's annotations precisely filled that shortcoming. Further, we can even say that these commentaries gave to each type of algorithm in *The Nine Chapters* a brief but comprehensive proof, proving the correctness of these algorithms."[43]

What is important now is that, if we compare Li Yan's 1958 *Revised edition* to the first edition of *An Outline of Chinese Mathematics*, which appeared in 1931, the shift is clear. In the first edition, the section on *The Nine Chapters* emphasizes the documentary evidence available, whereas the section on Liu Hui's commentary outlines the mathematical content of the canon, before describing Liu Hui's calculation for new values for π and his procedures in the *Mathematical Canon of the Sea Island* (Li Yan李儼 1931, 29–35). In other terms, Li Yan's first edition belongs to the first phase, whereas the revised edition as well as other books at the time were characteristic of the second.[44]

[42] In addition to the themes usually found in previous publications and summarized above, the way in which Liu Hui established the correctness of the algorithms for the volumes of solids is also emphasized in chapter 3 of (Yabuuti Kiyosi 1974). For analyzing how this book approached the commentaries, I was able to rely on the translation into French published in (Yabuuti Kiyosi 2000).

[43] (Li Yan and Du Shiran 1963, 77). It is worth stressing that we find in the original text the first occurrence of the claim that the commentator "established the correctness of algorithms," by contrast to the claim that one would have proofs comparable to those recorded in Euclid's *Elements*. As far as I can tell, it required the influence of Wu Wenjun's approach to the ancient Chinese mathematical sources from an algorithmic point of view, developed in the 1980s, for this approach to the commentaries to resume developing much later on. In relation to this claim, the authors gave a richer set of illustrations than Li Yan could give a few years earlier. This book was translated into English. However, note that the English translation of this precise statement, which is quite important for what it reveals of the understanding that was developing in China at the time, is misleading: "We know that the *Nine Chapters* listed general methods of calculation but the explanations and discussions are very brief. The commentary by Liu Hui manages to make up for those deficiencies. We can go one step further and say that the commentary and explanations for *The Nine Chapters* gave brief proofs for the various types of calculation and verified the accuracy of the calculation." (Li Yan and Du Shiran 1987).

[44] I am grateful to my colleague, Professor Tian Miao, for having copied Li Yan's first edition for me. To be precise, in the two editions, Li Yan comes back to *The Nine Chapters* amongst the other canons, when dealing with the procedure for root extraction, the solution of systems of simultaneous linear equations, areas and volumes. There Liu Hui is mentioned for the new procedures he introduced.

The same development can be perceived in Qian Baocong's writings. The 1964 edition of his *History of mathematics in China* strongly emphasizes the proofs that Liu Hui develops. In it, we find the recurring use of the terms "proof (*zhengming*)," "theorems," and even an occurrence of "axiom," all specifically in the sections about geometry (Qian Baocong 錢寶琮 1964, 64–65). Interestingly enough, we can also identify a change in Qian Baocong's account precisely on this question, if we compare that book to the earlier *History of mathematics in China* from 1932.[45] In the latter, the chapter on Liu Hui is substantial. Qian Baocong refers to Liu Hui's development of the algorithm provided by *The Nine Chapters* for the area of the circle as a "proof of its correctness." However, the emphasis remains on Liu Hui's new computation of π. Moreover, Qian Baocong refers to Liu Hui's "method of proving (*zhengfa*)" the formulas for the volumes of solids. But he immediately qualifies them as much inferior to what Greek texts contain, even though concise, easy to understand and beneficial for use (Qian Baocong 錢寶琮 1932, 215–217). In sum, we do not find in the first edition the emphasis on proofs that permeates the second edition. However, let us note that Qian Baocong does not limit his discussion about Liu Hui to a comparison with Euclidean proofs, emphasizing also theoretical dimensions specific to the writing.

In sum, for these writings of the 1950s and 1960s, we can establish a correlation between the emphasis placed on geometry and the interest in identifying "axioms" or "proofs" in the sources. In my view, both features reveal the impact of a historiography of mathematics overemphasizing "Western" sources, and the value it grants to Euclidean proofs, on the historiography in China at the time. Furthermore, Qian Baocong's second edition clearly chimes with the political environment of the time and found in Liu Hui a scientist with materialist inclinations (p. 61–62). It would be interesting to further pursue the hypothesis that the Chinese revolution of 1949 may have ushered in a change in the historiography of mathematics, which led to placing emphasis on proofs and thus on the texts in which it could be argued that proofs were sketched out, that is, the commentaries. It is probably revealing, in this light, that it was Qian Baocong who in 1963 was to redo the critical edition of the *Ten Canons*, an enterprise that had not been undertaken since Dai Zhen's time. Even though Ho Peng Yoke's biography of Liu Hui mentions all these publications, he includes in it none of these new developments. It would be interesting to understand the reasons for this silence.

This research work marks a new period with respect to the collection, which I would characterize by two main features. On the one hand, historical research on the mathematics of ancient China mainly focuses on proofs. It thus focuses on the commentaries, which later also become the main source material for inquiring more systematically into the theoretical dimensions of mathematical activity in ancient China. In other words, historical research on the collection is driven by

[45] (Qian Baocong 錢寶琮 1932), quoted from the edition in (Li and Qian 1998).

an interest in proof or theory. On the other hand, even though attention is now systematically paid to the commentaries, I would argue that, in continuity with the preceding period, historians again mainly read them as other subsequent texts, and not as commentaries. Such a feature can for example be captured by the presence of the theme of the "progress" that commentaries manifested with respect to what was originally in the canon. Moreover, no questions are raised as to the nature of the canon as text, the way in which the commentators read or interpreted it or what it meant to write a commentary.

As for western languages, Donald Wagner's master thesis and subsequent publications in the 1970s can be viewed as belonging to this period. The title of the thesis, *Proof in ancient Chinese mathematics: Liu Hui on the volumes of rectilinear solids*,[46] reveals the focus simultaneously on, proof and the commentaries. Moreover, geometry is again its privileged subject matter, which maybe reveals an abiding influence of a historiography overemphasizing Greek mathematics. In China, on the other hand, the Cultural Revolution seems to have interrupted research on the history of mathematics. However, when it resumed in the 1980s, with a series of publications far too numerous to be reviewed here, the commentaries were still a major topic of interest, along the lines that had emerged earlier in Li Yan's and Qian Baocong's publications.

A periodization of the reading of the commentaries as proofs could be offered that would show in a more precise way the part played by the question of mathematical proof in driving the interest of historians towards the commentaries. It would highlight how, after a first period when the focus was on those commentaries that contain "Euclidean-like" proofs, the interest widened. Yet, the motivation to look to commentaries only for proofs and theory is probably what accounts for the fact that large stretches of them were left untouched. A clue will suffice to support that point: commentaries regularly mention specific values for the magnitudes considered, or particular problems, and yet that feature was, as far as I know, never addressed as such by historians.

This research work has taught us everything we know about *The Nine Chapters* and its two traditional commentaries. And yet, as I hope to have shown, following their own agendas has led the authors to concentrate successively on specific parts of the collection. The questions of the status of these parts and how they held together were not meaningful within the context of the research programs I have outlined. As a result, some simple questions still remain unanswered. As I recall in the first paragraph of this chapter, from early on *The Nine Chapters* was granted the status of a "canon *jing*." Why was this done and what does it mean? Accordingly, some authors chose to write commentaries on that text and not independent writings of their own. Why did they opt for this mode of expression? What did it mean to write a commentary on *The Nine Chapters*? And what can we learn from reading their commentaries as commentary? Moreover, why have these texts been handed down as they were, that is, as part of a collection that has become a

[46] (Wagner 1975 (1 March 1976)).

cohesive whole? My claim is that to address these issues, we now need to approach the collection not in separate pieces, but as it has been handed down to us, paying attention to the distinct status that the various parts have in this whole. As a consequence, we shall be led to consider parts of the commentary that have not yet been analyzed. Moreover, this approach will provide a standpoint from which to understand how, within the framework of mathematics, commenting on a canon led to addressing the question of proof.

Approaching the Collection as Shaped by Various Actors: Elements of a History of Reading

Let us hence consider the collection as shaped by various actors and see what can be gained from attending to the textual categories of the various parts composing it.

As we see above, the core text, which was granted the status of "canon," is, roughly speaking, composed of seemingly concrete problems. This feature led some historians to perceive *The Nine Chapters* as a "practical handbook." Such a view appeared to some of them to be confirmed by the fact that these problems were followed by procedures solving them, which historians regularly interpreted as "rules" to be used blindly by practitioners. Yet how can one explain in that way the fact that some procedures were given independently of the formulation of a problem?

Clearly, such an interpretation of *The Nine Chapters* derives from reading it as the modern text that would correspond to it. However, the anachronistic feature of this approach is obvious. Moreover, interpreting as a mere "practical handbook" a book that past actors regularly considered to be the "foremost of the canons" may not be the most favorable starting point for making sense of the tradition that took *The Nine Chapters* as a reference book. These remarks lead us to two questions, which will allow us to tackle our research program.

First, how should we read *The Nine Chapters*? As we see above, Wylie expresses subtle views about the operations that past Chinese readers carried out on the basis of the text, without, as far as I know, attempting to find evidence supporting them. Yet, such evidence exists: the canon was handed down together with commentaries, and observing how the commentators read *The Nine Chapters* appears to provide a privileged access for examining this question. This is the first example of what can be done by approaching the collection as a whole.

Secondly, how was such a text possibly considered a canon and even the most important of all canons? Here again, observing not only *how* the commentators read it, but also *what* they read in the canon, and what they were looking for, provides evidence to address this issue. This is how I suggest reading the commentaries as commentaries and accordingly taking the fact that a text was a canon as a puzzle, rather than an unproblematic detail.

How Did the Commentators Read the Nine Chapters?

Liu Hui's preface provides key elements to approach his reading of *The Nine Chapters*. Let us take as our starting point his own description of his personal experience with the book:

> As a child, I studied *The Nine Chapters*; when adult, I again looked over it in detail. Through observing the dividing of *Yin* and *Yang*, I synthesized the *source of mathematical procedures*. During a moment of leisure while I was *fathoming its depths*, I eventually *managed to understand its meaning/intention*[47] (*yi*). This is why I dared (...) compose a commentary on it. 徽幼習《九章》，長再詳覽，觀陰陽之割裂，總算術之根源，探賾之暇，遂悟其意，是以敢(...)爲之作注。 (My emphasis). (Chemla and Guo Shuchun 2004, 126–127).

If we follow Liu Hui's narrative, we can conclude that the "meaning" of *The Nine Chapters* to which he refers with the term *yi* was what he looked for in the text and that which his commentary deals with or makes explicit. Interestingly enough, this purpose fits with the expectations of the thirteenth century editor of the anthology, Bao Huanzhi, when he deplores the loss of the commentaries. We have already quoted his statement about the first copies of *The Nine Chapters* he finds: "None of them had the old commentaries by Liu Hui and Li Chunfeng. The "meaning/reasoning (*yi*)" of the ancients could no longer be understood, which made (me) constantly sigh with regret."[48] This shows a conformity between the type of content Song readers of the collection were seeking in the commentaries and what earlier commentators had put in them.

Such a quest may appear to designate a general and unspecific approach to a canon. However, my claim is that within the framework of mathematics we can interpret this general "meaning," commonly ascribed to a canon, in a more specific way. In fact, observing the use of the term "*yi* meaning" in the commentaries on *The Nine Chapters* suggests that within mathematics, *yi* came to designate a specific type of meaning, which I shall now attempt to describe.

It is useful here to recall that, as the full title of the canon indicates, *The Nine Chapters on mathematical procedures* contains procedures—or, in modern terms, "algorithms"—, most often given in relation to problems.[49] The commentaries bear essentially on this part of the text of the canon, which is already an indication that the exegetes believed that the *yi* of *The Nine Chapters* mainly lay in its procedures.

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[47] As is suggested by the development on this term below, this may also be understood in the plural: "its meanings/intentions." Alternatively, if the anaphora refers to the mathematical procedures, this can also be interpreted as "their meaning/intentions." We come back to this point. The end of Liu Hui's preface uses this term *yi* again in relation to the content of his commentary and that which he attempts at recovering. On the interpretation of this term, see the Glossary I compiled and published in (Chemla and Guo Shuchun 2004, 1018–1022).

[48] See also the statement quoted in footnote 18.

[49] In the 1980s, Wu Wenjun played a key part to promote the idea that these procedures had to be read as algorithms and not as ordinary statements. Such a shift in the research work on *The Nine Chapters* was a prerequisite for developments of the kind that follow.

Roughly speaking, a procedure is a list of operations that, starting from the data given in the statement of a problem, provides a sequence of specific operations to be followed to yield, as a final result, the magnitudes sought, with values attached to them. If we think, for instance, of the procedure described to carry out subtraction between fractions (after problem 1.11 in *The Nine Chapters*), it explains how to make use of the numerators and denominators of the fractions given in the outline of the problem to find out their difference.[50]

How do the commentators attach "meanings *yi*" to these objects and make them explicit? The example just given provides the opportunity for a commentator to use the term *yi* in a way that sheds light on this question from a first angle. The main reason why this passage is revealing is that, just after the procedure for "Subtracting fractions," *The Nine Chapters* formulates a second set of problems asking to "compare" two fractions and determine by how much the larger exceeds the smaller. The important point for us here is that the procedure given for "Comparing parts" has exactly the same list of operations as the one for "Subtracting parts." This is easy to understand: to determine the excess of one fraction with respect to another, the procedure amounts to subtracting one from the other. The only difference between the two procedures is that the procedure for "Comparing parts" is concluded by a statement which is missing in the first and which makes the nature of the result explicit: "hence the surplus of one with respect to the other." It is as a commentary on "Comparing parts" that Li Chunfeng introduces in a contrasting way two types of "meaning." As an echo to the fact that the two procedures are constituted by the same list of operations, the commentator observes that their "meaning *yi'* 義 is the same."[51] Let us for the moment leave this remark aside and turn to what he declares with respect to the other kind of meaning:

> 唯相多之數，意與減分有異：減分知，求其餘數有幾;課分知，以其餘數相多也。
> Only for the 'quantity of the surplus of one with respect to the other,' the intention/meaning (*yi*) presents differences with (that in the operation) 'Subtracting parts' : 'Subtracting parts' is to look for how much there is in the corresponding remaining quantity, whereas 'Comparing parts' is to take the corresponding remaining quantity as the 'Surplus of one with respect to the other'.[52]

What can we learn from this use of the term *yi*? Despite the fact that the operations yielding the results are the same, Li Chunfeng stresses that the "intention" behind the use of the operations, and hence the interpretation of

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[50] In this case, the sequence amounts to three operations: multiplying each numerator by the denominator of the other fraction, subtracting the greatest of the resulting numbers from the smallest; lastly, taking this as dividend and the product of the denominators as divisor yields the difference.

[51] We come back below to this second kind of "meaning." I transcribe it as "*yi'*" to distinguish it from the first one.

[52] My use of quotation marks in the translation is the result of a convention: quotation marks indicate that the Chinese text is quoting the canon. The translation of both occurrences can differ for reasons of differences of syntax between English and Classical Chinese.

the results, presents a difference. The explanation of the contrast is straightforward: In the former case, we aim to obtain a remainder, in the latter the remainder is interpreted in relation to the context in which it is sought as a "surplus." The *yi* of the list of operations thus appears to capture the *intention* motivating the use of an operation or a sequence of operations. It is expressed by an account of the meaning of the result in terms of the situation within the context of which it is obtained. Note that in some cases, such as "Comparing parts," the text of the procedure in *The Nine Chapters* makes the "meaning" of the result explicit. This elucidation on the sense of *yi* is fundamental for our argument. On this basis, *yi* takes on other significations.

In the example examined, the *yi* formulated is that of the whole procedure globally. In other examples, commentators make the *yi* of subprocedures explicit in the same way. Moreover, it is the combination of such *yi* of the various steps of a procedure, as providing finally the meaning of the end-result, that Liu Hui also designates with the term of *yi*. A commentary on "the other procedure" placed after problem 7.4 is quite revealing in this respect. We shall not dwell on the mathematical meaning, but focus on the term *yi*. After three steps, the procedure yields one of the results sought: a number of people. Here is how the commentary makes the "*yi* of the procedure" explicit:

> "此術意謂" (Here is a quotation of step 1) "爲衆人之差"。(Here is a quotation of step 2) "爲一人之差。以一人之差，故得人數也" "The intention/meaning of the procedure is that" (Here is a quotation of step 1) "makes the difference (between quantities paid) by the whole group of people ; that when" (Here is a quotation of step 2), "the remainder makes the difference (between quantities paid) by 1 person, and that since one simplifies the difference for the whole group of people by the difference for one person, one gets as a consequence the quantity of people." (Chemla and Guo Shuchun 2004, 564–565).

The final step is reformulated on the basis of the meaning made explicit for the first two steps. The reformulation allows making sense of the result as what one was looking for. We can hence observe here how the combination of the meanings/intentions of the three steps of the procedure, in the sense of *yi* explained above, constitutes the *yi* of the procedure: the term appears to designate here not only the "meaning" of the end-result, but also the sequence of "intentions" leading to it. In other words, *yi* refers to the reasoning establishing the adequacy between what the procedure yields and what was sought, in a context in which the reasoning takes the shape of making clear how the meanings of the results of the succeeding steps lead to the end-result.

Several other occurrences of the term *yi* confirm this interpretation of its signification, in the commentators' use of it. When at the end of the commentary on the procedure following problem 5.11, Liu Hui makes explicit "the intention/reasoning *yi* for making the procedure 為術之意," what he develops are the main lines of the reasoning underlying the making of the procedure, in terms of the intention that its main steps fulfil or, in other words, the meanings of the succeeding results. Moreover, on several occasions, the commentators compare different ways of prescribing an operation in a procedure, or different operations, to conclude that

their "*yi* is the same" (4.0, 6.2, 6.3, 6.10): one can reach the same result or carry out the same intention through different means or by conceiving of the means in different ways. By contrast, in one case procedures that the commentators compare yield the same result but through paths—and hence a sequence of intentions—that differ. It is quite revealing that the commentary then concludes: "even though each has its own meaning *yi*, they do amount to the same 意各有所在而同歸耳." (Chemla and Guo Shuchun 2004, 442–443). In conclusion of this brief survey, it appears that the *yi* is not limited to designating the "meaning" of the result, the "intention" of the procedure, but it also includes the sequence of meanings and intentions, that is the reasoning, that led to the result.

Such an interpretation allows sense to be made of the question Li Chunfeng asks, after having quoted Zu Gengzhi's procedure for calculating the diameter of the sphere: "What is its meaning *yi*? 其意何也?"[53] It is coherent with the fact that this question is followed by the development of the reasoning establishing why this procedure is correct. Another occurrence of *yi* in the previous passage, attributed to Liu Hui, clearly has the same meaning. Moreover, it will bring us back to the question of how this relates to the exegesis of the canon.

In order to determine the diameter of the sphere when one knows its volume (problems 4.23 and 4.24), *The Nine Chapters* formulates a procedure. Liu Hui develops a reasoning accounting for it, before stating: "But this meaning/reasoning (*yi*) is wrong 然此意 非也." On the basis of our previous analysis, it is clear that the statement has two layers of signification. On the one hand, it states that the meaning of the end-result differs from the intended one. On the other, the commentator refers to the reasoning just developed to expose its deficiency. In relation to this statement, immediately afterwards, Liu Hui brings to light the actual meaning of the essential part of the procedure, which makes clear why the reasoning is defective.

Here two interpretations are possible. Either Liu Hui attributes the shortcoming of the reasoning to himself, criticizing himself for not having rightly restored the reasoning accounting for the procedure of the canon. Or he believes that the first part of his commentary was merely making explicit the "intention/meaning *yi*" he read in the procedure of the canon. On the basis of other pieces of evidence that I shall not discuss here, I opt for the second branch of the alternative.[54] Such an interpretation of the statement fits with Liu Hui's declaration in his preface, that is, that his commentary derives from having understood the "meaning(s)/intention(s)" of the ancients or of the canon.

At this point, let us summarize our conclusions. The commentators systematically comment on the procedures described in *The Nine chapters*. Their commentaries bring to light the "meaning" of the canon, which, in this case, takes the shape of the meaning of the successive steps or subprocedures of the procedure

[53] The whole passage on which we rely here can be found in (Chemla and Guo Shuchun 2004, 378–385). The argument outlined here is developed in greater detail in (Chemla 2008a).

[54] Further evidence is discussed in (Chemla 1991, 1992, 1997/1998).

and, in the end, the meaning of the end-result(s). The key point is that such a search for the meaning *yi* amounts to establishing the correctness of procedures. This is why there is an adequacy between what proving the correctness of an algorithm can be and how the commentators carry out their search for the "meaning" of the procedures. This suggestion accounts for why, within the context of mathematics, exegesis took the shape of proving the correctness of algorithms.

The crucial element here is understanding the significance of the fact that, in *The Nine Chapters*, mathematical knowledge takes the shape of procedures—a fact, as I say above, rightly emphasized by Wu Wenjun. As a consequence, what is to be proved is the fact that the algorithms described actually yield what is sought. And this type of proof necessarily entails making explicit in one way or another the meanings of the successive steps. In other words, the statements addressed by the proofs are of a type different from those most common in Euclid's *Elements*. The proofs developed can happen to look like one another: these parts of the commentaries were the first ones dealt with when the historians' attention was drawn to the commentaries in relation to their search for proofs in ancient China. However, viewing the commentaries from the perspective suggested here allows us to account for their content uniformly. Lastly, the commentators appear to have attributed the "meaning" thus brought to light to the authors of the canon themselves. This is the additional element allowing the establishing of a link between the *yi* sought and the type of proofs found in the commentaries.

Another crucial element will emerge from considering how the commentators make the *yi* explicit. If this operation is essential for proving the correctness of algorithms, it can be carried out in various ways. Understanding how the commentators attended to this task will now help us understand the feature that historians systematically leave aside in their exegesis: the use of particular problems or of particular values.

Modalities of Bringing the yi *to Light*

A statement made by Liu Hui in his commentary on the "procedure of the positive and the negative" provides an adequate starting point here. Problem 8.3 describes a situation in which mixing on three occasions quantities of three different qualities of millet yields, each time, a given quantity of grain. The question is to determine the amount of grain produced by a capacity unit of each of the distinct types of millet. In addition to the general procedure described at the beginning of chapter 8, another procedure is needed to solve problem 8.3 and the ones following in the chapter: the "procedure of the positive and the negative," which contains two main clauses explaining how to use the general procedure when one is confronted with positive and negative numbers. This additional procedure is described after the statement of problem 8.3, even though it is formulated in completely abstract terms and deals with the general problem, and not the particular situation of 8.3. Yet the commentator

insists: “One has hence composed these two clauses and one tied them on purpose to millet to show fully the meaning of these two clauses 著此二條, 特繫之禾以成此二條之意” (Chemla and Guo Shuchun 2004, 624–625). Liu Hui thereby testifies to a connection that is essential for our purpose: he links the fact of using the context of a problem—here the millet—and the possibility of bringing to light the *yi* of a procedure. Moreover, he attributes the intention of this connection to the authors of the canon. If we go back to the examples evoked above, where we outline how the commentators make the *yi* explicit, his statement makes sense. When he expresses the difference between the *yi* of “Comparing parts” and “Subtracting parts,” the commentator refers to the abstract situations with which the related problems are formulated and considers only the aim assigned to the search. By contrast, to make explicit the *yi* of the “other procedure,” given after problem 7.4, Liu Hui needs to rely on the situation when a group of people are buying something to express the meaning of the various steps in the procedure and, in the end, the meaning of the end-result. The “other procedure” is general, but the commentator makes use of a specific situation to highlight its *yi*. Both types of situation—describing the *yi* either in abstract terms or in the specific terms of a situation provided by a particular problem, and even making use of its specific values—are common in the commentaries.

The latter branch of the alternative clearly relates to the use of particular problems or values from the canon within the commentary. It accounts for why and how commentators use these problems and values, which is precisely the feature we need to understand. This conclusion suggests a use for the problems found in the canon that is radically different from the one we would assume, if we rely on our own experience with mathematical problems. To understand this option better, it is important to inquire further into what a problem may have been in ancient China.[55] The key point is that it would be impossible to address this issue, if we had not had the possibility of observing how commentators read the problems in the canon. This is another fundamental reason not to dissociate the collection: the commentators provide us with evidence allowing us to argue for a way of reading the canon, in this case, the problems of *The Nine Chapters*, in a less “spontaneous” and more documented way.

In addition to the observation made above, we can establish that the commentators read a problem in *The Nine Chapters* as standing for a category of problems. More precisely, they rely on the procedure attached to the problem to determine the class of problems for which it stands. We can reach these conclusions regarding the actors’ interpretation of the canon again thanks to evidence found in the commentaries. In the only case, when the procedure provided by *The Nine Chapters* was not

[55] I dealt with this question from different viewpoints in (Chemla 1997, 2000, 2003a, 2009). I only make use of the conclusions here without repeating the argument. The second paper gives reasons to believe that, in the commentators’ eyes, the problems provided in *The Nine Chapters* were meant to clarify the *yi* of the procedure. It also suggests that there may have existed a culture of mathematical problems in ancient China, elaborated for that use.

general enough, but solved only the preceding problem and other quite specific similar problems, Liu Hui exposes the lack of generality. He does so by introducing a problem similar to that in *The Nine Chapters* which the procedure in the canon fails to solve. He then suggests a modification of the procedure enabling it to cover a large class of problems similar to that in *The Nine Chapters*. The essential point for us here is that this passage reveals how the particular—a specific situation as well as specific values—is read as a general statement.

The two conclusions on the use of problems just outlined concern how commentators read problems in the canon and interpret their use. In fact, the conclusions also cast light on how we can read problems in the commentaries and interpret their use in the course of proving the correctness of algorithms. This remark shows the complex arguments that the treatment of the collection as a whole allows us to develop. First, when commentators use a particular problem or specific values in their exegesis, these are meant to be read as those in the canon, that is, as standing for a class to be determined on the basis of the operations expounded. Secondly, there are cases when the operations required by a proof are more numerous than those required by the procedure the correctness of which has been established. In such cases, the commentators change the problem in *The Nine Chapters* to replace it by another particular problem, the situation of which is rich enough to allow bringing the *yi* of all operations to light.[56] Again, this new problem is to be read as general. Thirdly, to prove the correctness of procedures given outside the framework of any problem, the commentaries systematically introduce particular problems. Again, these are used as any other problem, that is, as allowing the making the *yi* of the operations in the proof explicit and as standing for all similar problems for which these operations can be interpreted.

As a result, we come up with a unique conclusion regarding problems—and specific values: whether we deal with problems in the canon or in the commentaries, they are all to be read as general in the same way, and they are all used to bring to light the *yi* of the procedure. Let me stress that this interpretation of the problems in *The Nine Chapters* relates to both a suggestion as to how the canon should be read and a hypothesis on the practice with problems in ancient China. This account shows how misleading a reading could be that reduces problems to practical questions.

To reach this conclusion, we need to rely on the collection as a whole and attend to the status of its distinct parts. Reading commentaries as commentaries implies paying attention to how the commentators read *The Nine chapters*. This helped in restoring practices related to those that produced the canon. Moreover, this brings to light continuities between the practices at the time the canon was composed and those to which the commentaries attest,—continuities which the opposition 'statement for *The Nine Chapters*'/'proof in the commentaries'

[56] The best example is that of "Multiplying parts" (1.21), see the papers mentioned in the previous footnote.

would hide. More could be done in this respect, but we cannot develop that remark here.

Let us go back, instead, to our analysis of how the commentators made the *yi* explicit. In fact, in addition to the practice discussed above, the commentators use a second type of artifact to capture the *yi* : designing figures (*tu* 圖), or blocks (*qi* 棊). At the very point in the canon that one moves from plane to space geometry, for the extraction of the cube root, Liu Hui introduces blocks and justifies the use of this new type of object, by quoting the "Commentary on the Attached verbalizations 繫辭傳," the first and main commentary in the *Yijing* : "Speech does not exhaust the meaning *yi* 言不盡意." This quotation is quite important. On the one hand, it reveals the link between the visual tools used by the commentators—and only by them—and the purpose of making the *yi* explicit. On the other, it shows that this quest for the *yi* is understood as being connected to a much more general enterprise, which goes well beyond the realm of mathematics, even though it may take specific forms within mathematics.

How are these visual tools used for dealing with the *yi*? In the same way as mathematical problems, figures or blocks systematically have specific dimensions. We can interpret this feature in the same way: they are used like problems, and the particular is meant to be general.[57] Moreover, they are used to determine the meaning of operations in a procedure or the meaning of operations necessary to establish the correctness of the procedure. As quite often, a richer set of forms are needed for establishing the correctness than for stating the procedure, other and richer geometrical figures or blocks are introduced in geometrical questions.

Let us sum up our conclusions so far. The interpretation we offer for the *yi*, like that which commentators concentrate on in their approach to the canon, gives us a clue to account for why within the framework of mathematics, the type of exegesis illustrated by the commentaries came to be establishing the correctness of the algorithms. This interpretation has two consequences important for our purpose. On the one hand, in terms of proofs, it allows the discovery of a point of view to account uniformly for the commentaries on each procedure of *The Nine Chapters*. On the other, it offers a clue regarding the shaping, and the use, of the collection: since the canon was, as far as we can tell, always edited with such commentaries, readers in China always had the procedures of the canon, with the proofs, "restored" or "read," made explicit by commentators. These conclusions suggest an interpretation for Bao Huanzhi's expectation, when he explains why he looked for editions having commentaries and thereby giving access to the *yi* of the ancients.

Moreover, by examining further the way in which the commentators approach the formulation of the *yi* as we interpret it revealed an unexpected relation between mathematical problems and visual tools. Both reveal similar

[57] On the question of the generality of figures in ancient China, see (Chemla 2005).

features, in my view for the same reasons. In addition, both are used in the same way to bring out the *yi*. Such a conclusion presupposes restoring mathematical practices of the past, through making use of the collection as such. These arguments illustrate, in my view, how the collection with its distinct parts yields evidence to support an interpretation of the canon or the commentaries.

As these conclusions suggest, "commentaries" are not a kind of text that is the same everywhere and in every period. On the contrary, despite the fact that commentaries may share similar formal features, they constitute a category of text that needs to be described in each historical context and on the basis of historical evidence. The same holds true for the type of text a canon was. It is to this last point that we shall now turn, attempting to highlight in which specificities the approach to *The Nine Chapters* reflects the belief that it was a canon, and even "the foremost of all canons."

Reading The Nine Chapters *as a Canon*

On the basis of what we see above, the question of understanding what it means, in the commentators' view, that *The Nine Chapters* be considered a canon can be reformulated more specifically. We may ask what motivated the search for the *yi* of *The Nine Chapters*. What was the ambition of this quest carried out by the exegetes, which assumed that *The Nine Chapters* was a (very) special type of text?

The answer I give to the questions relies on two observations.

First, all the commentators on *The Nine Chapters* whose exegesis survive to this day have formulated a list of fundamental operations from which, in their view, all mathematical knowledge derives.[58]

Second, the way in which proofs are carried out in the commentaries brings to light fundamental operations that underlie the procedure, the correctness of which is to be established.

The two facts are correlated since the operations brought to light through inquiring into the *yi* of a procedure are the very ones that are found in the lists stated by the commentators. This fact implies that the proofs on distinct procedures were not carried out independently of each other. Rather, they seem to have been reworked in correlation to each other, in order that the common fundamental operations they point to are brought out.

These observations lead me to the hypothesis that the commentators believed that the canon indicates in this way the most fundamental operations required for devising any procedure. In other ways, the fact for *The Nine Chapters* to be a canon meant for the commentators the belief that, through delving into its depths, they would unearth the most fundamental operations. Moreover, as a canon, *The Nine Chapters* would contain in this way all

[58] This point is made in greater detail in (Chemla 2003b, 2008b).

fundamental operations and thereby cover all mathematical procedures. Let us note that, even though all the commentators express their faith that the canon encompasses all mathematical knowledge, they differ on the list of fundamental operations they suggest.

Two pieces of evidence seem to me to support this conclusion. On the one hand, we encountered earlier another term referring to a type of "meaning" for procedures: the term *yi'* 義. If we analyze the way in which our commentators use this term, it appears to refer precisely to the meaning of a procedure expressed by means of the fundamental procedures underlying it and brought to light through the proof. Let me stress that such a meaning could only be found through 'tuning' the proofs of different procedures, as the strings of a musical instrument are tuned relative to one another, in such a way that together they reveal the *yi'*. Moreover, if we turn again to Liu Hui's preface, it clearly indicates the aim of his commentary as attempting to synthesize the "source of mathematical procedures." This source can be interpreted as referring to the list mentioned.[59] Identifying what constitutes this source may be what Liu Hui eventually understood and what convinced him to compose his commentary, as we saw above.

In conclusion, in the commentators' view, *The Nine Chapters* is a canon in that it is understood as pointing to, and thereby containing, all fundamental operations. It is interesting that this conclusion fits with Bao Huanzhi's declaration in his 1200 postface, quoted above:

> Among the books of mathematical procedures, there are altogether ten schools. *One can only consider* The Nine Chapters *as being the foremost of the canons. With the methods of its nine parts of mathematics* (*jiu shu*), there is *nothing which is not complete*. Although the *procedures* established by the various schools *present variation*, *when one looks for the original meaning (yi), they all come from them*.

The quest of the *yi* leads to identifying that in the end all mathematical procedures derive from *The Nine Chapters*. This would mean that such an approach towards the canon presented a relative stability for several centuries.

At the end of this development, it is clear how anachronistic it may be to read the canon without attempting to restore at least what its successive readers sought in it. How the text was meant to be read and how it was read concretely by those who thought it was a canon appear to be two questions worth our attention. Approaching the collection as handed down by past actors offers, as I hope to have shown, evidence to address these issues.

Appendix 1: The *Ten Canons of Mathematics*

1. *The Gnomon of the Zhou [dynasty]* (*Zhoubi*). Composed around the beginning of the Common Era, it expounds the mathematics at the basis of

[59] This quest of Liu Hui's is strongly emphasized by (Guo Shuchun 郭書春 1992, 301–320).

calendar-making, within the framework of the cosmographical theory "Heaven like a chariot-cover (*Gaitian)*." (Cullen 1996) provides a translation of the canon. In conformity with the front pages of the edition printed during the Song dynasty, the received version contains a third century commentary by Zhao Shuang 趙爽, a sixth century subcommentary by Zhen Luan 甄鸞 (*fl. ca* 566) and a subcommentary on all previous layers composed under Li Chunfeng's supervision (Qian Baocong 錢寶琮 1963, 3–6).

2. *The Nine Chapters on Mathematical Procedures (Jiuzhang suanshu*), a title abbreviated to *The Nine Chapters*. The received version contains a commentary by Liu Hui and a subcommentary written under Li Chunfeng's supervision. The canon is mainly composed of problems and algorithms solving them. By contrast, the commentaries deal with the correctness of the algorithms and more generally offer reflections on mathematics.
3. The *Mathematical Canon of the Sea Island* (*Haidao suanjing*), written by the third century mathematician, Liu Hui. Liu Hui's preface to his commentary on *The Nine Chapters* diagnosed that the book, as restored by Han scholars, failed to cover all the categories of mathematical problems (Chemla 2008a). The *Mathematical Canon of the Sea Island*, devoted to measuring lengths at a distance, filled the gap indicated by the preface and was first composed as a complement to Chapter 9 of *The Nine Chapters* concerning the right-angled triangle. It was turned into an independent book in the Tang dynasty. The commentary that Liu Hui composed on it appears to have been lost at the time when the commentary written under Li Chunfeng's supervision was compiled (Qian Baocong 錢寶琮 1963, 261–263). (Swetz 1992) contains a translation.
4. The *Mathematical Canon by Master Sun* (*Sunzi suanjing*). (Qian Baocong 錢寶琮 1963, 275–276) argues that the book was composed around 400 CE, but stresses that the received version displays hints of later, Tang, changes. Moreover, in the Song dynasty printing, the front page of each chapter indicates that a commentary on it was composed under Li Chunfeng's supervision, but the printed version does not appear to contain it. (Lam and Ang 2004) provides a translation of the canon. Like *The Nine Chapters*, its second and third chapters present mathematical knowledge within the framework of problems and algorithms. They mainly deal with themes treated in *The Nine Chapters*. The first chapter, however, adopts another presentation, introducing sequences of measure units or of procedures, the basic algorithms for common arithmetical operations as well as rhyme tables. Due to the evidence provided by archaeology, we know that such modes of writing down mathematics go back to, at least, the Han dynasty (Peng Hao 彭浩 2001).
5. The *Mathematical Canon by Zhang Qiujian* (*Zhang Qiujian suanjing*). (Qian Baocong 錢寶琮 1963, 325–327) argues it was composed in the second half of the fifth century, whereas in the sixth century, Liu Xiaosun added detailed explanations about the execution of its procedures. Its shape and

topics basically follow those of *The Nine Chapters*. Among the two commentaries that the edition printed in the Song dynasty mentions on the front pages of each chapter, only the commentary composed under Li Chunfeng's supervision is still extant.

6. The *Mathematical Canon of the five Bureaus* (*Wucao suanjing*). (Qian Baocong 體錢寶琮 1963, 409) attributes its composition to Zhen Luan (sixth century). The book contains elementary procedures given in the framework of problems and useful for local government officials. It is divided according to the nature of the duties of various bureaus (fields, soldiers, assemblies, granaries, and finance). Despite the mentions on the front pages of the Song edition, no commentary composed under Li Chunfeng's supervision appears in the edition.
7. *The Mathematical Procedures of the five Canons* (*Wujing suanshu*). In this book, Zhen Luan (sixth century) compiles commentaries on passages of the Confucian canons requiring mathematical knowledge and adds technical explanations to them. The received version contains a commentary composed under Li Chunfeng's supervision (Qian Baocong 錢寶琮 1963, 437–438).
8. The *Mathematical Canon continuing the Ancients* (*Qigu suanjing*) was written by Wang Xiaotong in the first decades of the seventh century. Except for a first problem concerning an astronomical conjunction, the book gathers problems dealing with volumes or right-angled triangles, and to be solved by cubic, or biquadratic equations. The extant copy of the Song printed edition mentions that Wang Xiaotong wrote the book and commented himself on it. Ancient bibliographies mention the existence of a commentary written by Li Chunfeng. If it existed, it does not seem to have survived.
9. *Zhui shu* 綴術 by Zu Chongzhi (fifth century). The canon did not survive. It has been suggested that this was due perhaps to its high level. (Yan Dunjie 嚴敦傑 2000, 125–126, 139) gathers evidence showing that Li Chunfeng also produced a commentary on this book.
10. The *Mathematical Canon by Xiahou Yang* (*Xiahou Yang suanjing*), the composition of which (Qian Baocong 錢寶琮 1963, 551–553) dates to the eighth century. Qian argues that the book handed down was not the one that was originally included in the anthology, the substitution having occurred in the Song dynasty. The book describes algorithms to perform the basic arithmetical operations in a more convenient way, and introduces decimal fractions. Its topics follow on those dealt with in *The Nine Chapters*. Its presentation is a mixture of algorithms described within and without the context of problems. In sum, it is not surprising that Li Chunfeng's name is not associated with the book.

It is important to keep in mind that if we set aside the case of the *Memoir on the Methods of Numbering* (see footnote 5), the only mathematical books handed down through the written tradition were these canons.

Appendix 2

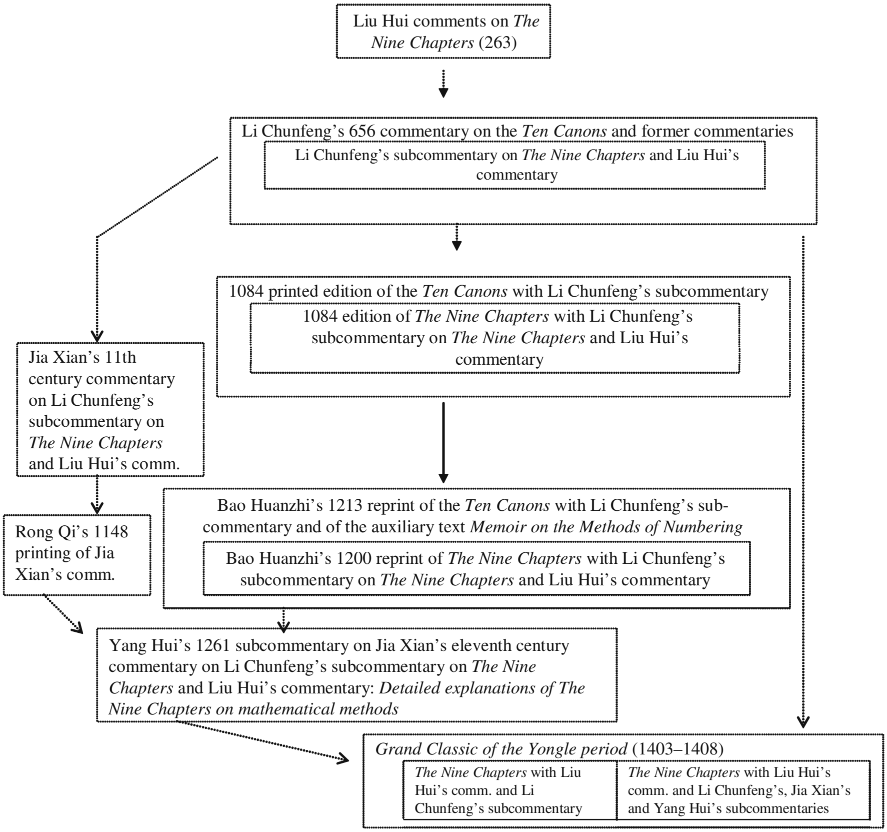


Fig. 1 Historical analysis of the early shaping and transmission of the collection
NB: A frame drawn with a continuous line indicates that an edition of the document still exists in its original form. Otherwise the frame is a dotted line. If the frame is only partly drawn in continuous line, only part of an edition still exists.
A frame surrounding another frame indicates that an edition was carried out within the framework of a larger editorial project.
An arrow that is dotted indicates that it is unclear by means of which documents the new edition relates to the older one.

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Youschkévitch, see Juschkewitsch.

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On Sanskrit Commentaries Dealing with Mathematics (Fifth–Twelfth Century)

Agathe Keller

Introduction

A renewed interest for contextualization in indological studies[1] is but slowly affecting publications on Indian mathematics. The isolation of history of mathematics within the general field of indology derives partly from a lively historiographical trend of technical and patriotic history of mathematics which remains oblivious to social science. Preservation plays a role as well: precious little information exists on the context in which mathematics and astronomy were practiced in India in the past.[2] To overcome this problem some historians of science have turned to periods (XVIth–XIXth century) and places where institutions, libraries and many texts help us contextualize their mathematical and astronomical ideas.[3]

A focus on the kind of texts produced by astronomers and mathematicians of the Indian subcontinent and the history of how they were transmitted to us aids the contextualization of the knowledge they contain. An explanation of the diversity of textual forms that were produced, examination of the functions these forms filled, consideration of their self-proclaimed purpose, and an elucidation of their own conceptions of mathematical practices and ideas can provide information about who produced mathematical texts, why they were

[1] For the fundamental project headed by Sheldon Pollock, “Sanskrit Knowledge Systems at the Eve of Colonialism” (SKEC), see http://www.columbia.edu/itc/mealac/pollock/sks, (Pollock 2002). For the results of this approach in literature (Pollock 2006).

[2] (Plofker 2009) struggles to link a technical history to social questions, but both fields remain estranged from one another today.

[3] Among the publications on history of science, produced within Pollock’s SKEC, see the works of Christopher Minkowski and Dominik Wujastyk, listed at http://www.columbia.edu/itc/mealac/pollock/sks/papers/index.html. We may add to this the recently defended thesis of Toke Lindegaard Knudsen, (Knudsen 2008).

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DOI 10.1007/978-90-481-3676-6_7,

produced and how they were used.[4] This contextualized approach may prove as fruitful for the history of mathematical practices and conceptions in India as it has elsewhere.[5] These questions of author, audience and use pertain even to texts of early periods for which very little background information is known.

Such a focus on the context of these texts requires clarification about which manuscripts can be found in libraries today, because they are the sources of editions and studies. Here, many questions arise[6]: Who copied the texts now at our disposal? Who had them copied? How were these texts used and read? How where these texts collected into libraries? Why? C. Minkowski and D. Raina address these questions more directly in their contributions to this volume.

In this contribution, however, the spotlight falls on the specific case of Sanskrit commentaries on mathematical subjects written between the fifth and the twelfth century A. D.,[7] with the broader purpose of understanding the social function of commentaries on mathematics. Therefore, this study will focus on how commentaries related to the texts which they were explicating. The answer to this question depends on an understanding of the points of view of three different sets of actors: those who wrote commentaries, those who had them copied, and those who analyzed them as historians of mathematics. The question of whether these actors were distinct must be addressed. Were commentaries on mathematics considered an adjunct but independent text? Were they thought of as reusable but ultimately disposable explanations to be summoned when useful to understanding an algorithm or an idea? In order to answer these questions, an attempt must be made to comprehend the scope of readings generated in India over time from an unchanging commentary.

Before these considerations, though, an introduction to what is known today about commentaries on the mathematics of the fifth to twelfth century. This introduction must situate these commentaries in the larger context of the literature on astral science (*jyotiṣa*).[8] Then, a description of the manuscripts at our disposal provides information about who copied these commentaries as well as how such texts were copied. A survey of selected histories of

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[4] A list of various categories of astronomical/astrological texts is given in (Pingree 1981) and reformulated in (Plofker 2009). Different kinds of texts, categorized by the subjects or styles they are likely to adopt, have long been identified by Indologists. Kim Plofker, 105–108, briefly contrasts the kind of trigonometrical astronomy stated in *karaṇas* with the astronomy given in *siddhāntas*. Mathematical difference and textual variations are noted, but not closely investigated. Plofker remarks that both kinds of texts received commentaries.

[5] K. Chemla has published extensively on this question. Her latest synthesis is (Chemla 2004).

[6] A similar set of questions about another kind of text, the colonial archives, can be found in (Stoler 2002).

[7] Stated more precisely, these commentaries were written between the seventh and twelfth century about texts which had been composed between the fifth and tenth century.

[8] *Jyotiṣa* (lit. "the ⟨sky's⟩ luminaries"), which is commonly translated as "astronomy," more exactly means "astral science" because the field includes horoscopy and mathematics together with observational and computational astronomy. See (Pingree 1981, Introduction and Table of contents).

mathematics in India begins with the nineteenth century and continues to the present. This survey gives special attention to the story of the rediscovery and edition of the works of Āryabhaṭa (ca. 499), Brahmagupta (ca. 628) and Śrīdhara (ca. 950) and will illustrate how commentaries on mathematics have been read in more recent times. Finally, a close look at algorithms for the extraction of square roots will serve as an illustration of an analysis of a mathematical text and focus on how commentaries relate to the text they explain, thereby providing insights on the ways mathematicians writing in sanskrit conceived of and used the decimal place value notation.

Commentaries on Mathematics from the Fifth to the Twelfth Century

Today, Indologists intent on making new editions may easily be overwhelmed by the number of manuscripts at their disposal. The case of Sanskrit astronomy and mathematics is quite exceptional in this respect, since a census has been undertaken which enables us to evaluate the number of manuscripts and published editions for the specific field of *jyotiṣa*. Indeed, David Pingree's *Census of the Exact Sciences in Sanskrit* (CESS)[9] lists most of the manuscripts on astronomy and mathematics in Sanskrit existing today.

The near exhaustivity of the CESS enables quantitative reflection on the collected and preserved manuscripts for astronomical, astrological or mathematical texts. Since the census not only gives manuscript references but tracks published editions, it can help us evaluate how many of these texts buried in manuscripts have been edited and studied in the last two hundred years. A close look at the census[10] shows that mathematical texts in Sanskrit have been significantly better-studied than texts on *jyotiṣa*. Indeed, texts on mathematics are comparatively rare in comparison to the other texts included in the census[11],

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[9] (Pingree 1970–95). In 1955, D. Pingree started (see CESS I, preface.) a survey of manuscripts on *jyotiṣa* that was remained unfinished when he died fifty years later in November, 2005. The CESS spans 5 volumes, and Pingree's death interrupted the completion of Volume 6. For authors who have not yet been treated in the published volumes of CESS, one can refer to (Sen, Bag, and Sarma 1966) and to individual library catalogs. Despite its name, the CESS lists texts in many languages of the Indian subcontinent. Pingree cast a large net when undertaking his census and included texts that may refer to some part of *jyotiṣa* only in passing. While some manuscripts doubtless existing in private collections have escaped classification by libraries or still others have been misclassified, most known manuscripts are probably included in his census.

[10] Because no electronic version of the text was available, the entries were counted manually: the evaluation may be subject to human error. Nonetheless, the investigation gives a general idea of the proportions involved. Since this investigation, the CESS has been partly digitalized (Volumes 1, 2 and 4) on http://books.google.com/. I have counted only manuscripts and have thus excluded references to authors for which there is no remaining text, as well as twentieth century publications by modern authors for which no manuscript remains.

[11] Indeed, of the 3,686 texts I have recorded in the first five volumes of the CESS, only 102 (2.7%) are clearly devoted at least partly to mathematics (*gaṇita*).

but those in Sanskrit have been much more actively edited, studied and translated than the texts concerned solely with astronomy or astrology.[12]

In this context, commentaries on mathematical texts have been closely studied, even though they do not represent much of the transmitted textual tradition.[13] However, as we will see, studies have often treated the commentaries in bits and pieces, or considered them independently from the texts they explicate. Furthermore, even when commentaries have been edited, they have not always been translated entirely. When compared with the sea of all astral texts known in Sanskrit, this specialized treatment of commentaries dealing with mathematics can be considered within the sub-set of known texts on mathematics for the period ranging from the fifth to twelfth century of our common era.

A Limited Number of Known Texts on Mathematics

All the presently identified texts on mathematics of the fifth to seventh century for which we have manuscripts are enumerated in Table 1. Some mathematical commentaries from this period are now lost to us, such as Prabhākara's commentary on the *Āryabhaṭīya* (ca.sixth century) (CESS 4 227 a), and Balabadhadra's (fl. eighth century) commentary to the *Brahmasphuṭasiddhānta* (CESS 4 255 a). These texts are not taken into account here.

The seventh to twelfth century is the beginning of an expanding mathematical and astronomical tradition. This tradition will permeate not only the Indian subcontinent, but extend in the East to China and in the West to the Arabic peninsula. We have chosen the time before the works of Bhāskara II (ca. 1114–1183) started to have an impact as an upper boundary. This decision enables us to include Sūryadeva Yājvan's commentary, which dates from some time after Bhāskara II (but is ignorant of his work) and after the Vedic period, which had its own specific mathematical style. The period we are considering thus ranges thus from 499 AD to 1200 precisely.

Although the number of mathematical texts transmitted is limited, their diversity is striking. This variety may be due in part to the limited autonomy of mathematics (*gaṇita*, "computation") with respect to astronomy. Indeed, a number of preserved texts on mathematics belong to astronomical treatises. To

[12] This list does not include texts which were edited and translated. However, among the 102 texts listed, a significant number are in vernacular languages (particularly, oriya and tamil) and have seldom been edited or even translated. A majority of the parts of the Sanskrit texts concerning *gaṇita* have been edited and translated.

[13] Of the 3,686 texts and 2,972 authors devoted to *jyotiṣa*, 816 (22%) are commentaries and 646 authors (21.7%) are commentators. Before starting this article, I believed that commentaries on mathematics had been largely neglected in the historiography of Indian science, and that they were an important part of the past tradition. Indeed, I mentioned this in the introduction to my book, (Keller 2006). This error was noted and rightly criticized by S. R. Sharma. (Sarma 2006, 144).

Table 1 A list of known texts on mathematics, in Sanskrit, fifth-twelfth century

Dates (A.D.)	Author	Title	Abbreviation
499	Āryabhaṭa	*Āryabhaṭīya* (Chapter 2)	Ab
628	Brahmagupta	*Brahmasputasiddhānta* (Chapter XII)	BSS
629	Bhāskara	*Āryabhaṭīyabhāṣya* (Chapter 2)	BAB
VIIth-Xth century	unknown	*Bhakshālī* manuscript	BM
ca 864	Pṛthudakśvamin	*Vāsanābhāṣya* on the BSS (verses of Chapter XII)	PBSS
850–950	Śrīdhara	*Pāṭīgaṇita*	PG
idem	idem	*Triśatika*[a]	T
tenth century	Mahāvīra	*Gaṇitasārasaṃgraha*	GSS
c. 1039 A.D.	Śrīpati	*Gaṇitatilaka*	GT
ca. 1040	Someśvara	on the *Āryabhaṭīya* (Chapter 2)	SAB
ca. 1150	Bhāskara II	*Līlāvatī*	L
idem	idem	*Bijagaṇita*	BG
[IXth-twelfth century	Āryabhaṭa II	*Mahāsiddhānta* (Chapters XV and XVIII)	MS][b]
ca. 1200	Sūryadeva Yajvan	on the *Āryabhaṭīya* (Chapter 2)	SYAB
[Unknown[c]	Unknown	commentary on the *Pāṭīgaṇita*	APG]

[a] As (Hayashi 1995) notes, we do not have any extant manuscript of his *Gaṇitapañcaviṃśi*

[b] According to André Billard (Billard, 1971 161), the *Mahāsiddhānta* contains observational data that was made in the first half of the sixteenth century. Generally, however, Āryabhaṭa II is considered to have lived between Śrīdhara and Bhāskara II (CESS I-II53). Thus, the text is provisionally added to this list

[c] Shukla, who edited the text, considers that the commentary shares features with texts in the time span we have delineated, such as the Bhakshālī Manuscript and the BSS. (Shukla, 1959, xxviii–xiv)

some extent, particularly for certain authors, Mathematics seems to have been a sub-discipline of astronomy. A commonly accepted use of *gaṇita* in this context is "computational astronomy." However, other Sanskrit authors of astronomical texts insisted that mathematics had an existence outside of astronomy.[14] This uncertain division explains why a certain number of procedures with no application in astronomy were stated in astronomical chapters. Additionally, from the Vedic time onwards, independent texts on mathematics have been preserved. Accordingly, mathematical texts in an astronomical context differed from autonomous mathematical texts. In the first and second part of this study, these disparate texts will be collected together in order to focus on the fact that they concentrate on a same subject matter, which has a specific name, *gaṇita*. In the third part of this study, the difference will emerge again.

Table 1 lists 15 texts. It includes two sets of texts. "Primary texts" contain treatises and all other texts that stand alone; "secondary texts" refer to those texts that depend on another composition. All the texts on mathematics known for this

[14] See for instance (Keller 2007) and (Plofker 2009).

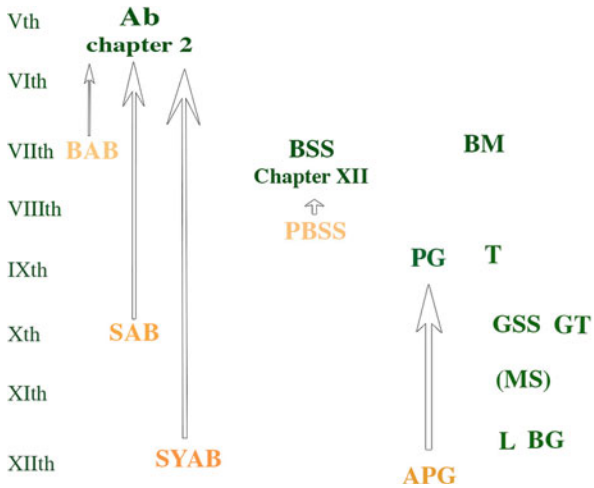


Fig. 1 Texts on mathematics in Sanskrit, from the seventh to twelfth century

period are summarized graphically in Fig. 1, which delineates between primary and secondary texts.

Texts so far identified as commentaries on the subject of *gaṇita*, written during our chosen period[15] and for which we have extant manuscripts are thus, in a chronological order:

- Bhāskara's commentary on the second chapter of the *Āryabhaṭīya* (629 A. D.; hereafter the treatise is abbreviated as Ab and the commentary as BAB, with implicit reference to chapter 2 when cited this way),
- Pṛthudakśvamin's mathematical commentary on the twelfth chapter of the *Brahmasphuṭasiddhānta* of Brahmagupta (the treatise dates to 628 A. D. and the commentary dates to ca. 864 A. D. ; hereafter the treatise is abbreviated as BSS and the commentary as PBSS, with implicit reference to chapter XII when cited this way),
- Someśvara's commentary on the second chapter of the *Āryabhaṭīya* (ca. 1040, hereafter abbreviated as SAB, with implicit reference to Chapter 2),
- Sūryadeva Yajvan's mathematical commentary on the *Āryabhaṭīya* (Sūryadeva Yajvan is believed to have been born in 1191 A. D., his commentary is hereafter abbreviated as SYAB, with implicit reference to Chapter 2). To these we might also add:
- the anonymous and undated commentary on the *Pāṭīgaṇita* of Śrīdhara (fl. 850–950 A.D, date unknown for the commentary[16]; hereafter the treatise is abbreviated as PG and the commentary as APG).

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[15] Commentaries on the treatises enumerated here have been written after our period but these commentaries are not listed here. We will return to this situation below.

[16] K. S. Shukla, who edited the text, believes that the commentary shares features with texts from the chosen time span. He especially draws similarities with the Bhakshālī Manuscript and the BSS. (Shukla 1959, xxviii–xxxiv.)

The following discussion concentrates especially on the edited commentaries of this list: BAB, SYAB and APG. First, let us return to the texts which these commentaries gloss. The *Āryabhaṭīya* has received extensive commentary. K. S. Shukla and K. V. Sarma count 19 commentators on the *Āryabhaṭīya*,[17] 12 of which are in Sanskrit. Half of these are from after the twelfth century. In the case of Brahmagupta's BSS, on the other hand, only two commentators are known. Furthermore, only seven manuscripts have been preserved for one commentary, PBSS. Among those, only two remain for PBSS's commentary of Chapter XII. Four manuscripts of the 34 remaining manuscripts of the BSS provide anonymous commentaries on BSS.[18] Finally, as far as I know, PG is known through a single manuscript which contains a similarly unique anonymous commentary on the text. Briefly stated, early treatises dealing with mathematics have not always come down to us with a great number of commentaries.

All of the primary texts enumerated here have been entirely edited and translated into English. The texts of Ab, BSS, BM, GSS, PG, L and BG have also been edited and translated into English.[19] All other texts have only been edited.[20] The BSS is, for this period, the only non-extensively edited treatise containing a mathematical part. Thus, BSS is an exception: only bits and pieces have been translated in English. This special situation probably derives from the fact that no extant ancient commentaries in surviving manuscripts are known for this text, part of which thus remains hard to understand.

Concerning commentaries, two (PBSS and BAB) have been partially translated into English,[21] but only one (the BAB) was translated for its mathematical part. A portion of SAB was edited together with BAB.[22] The situation concerning the editions and translations of these texts is given in Table 2 and Fig. 2. Setting aside the special cases of BSS and PBSS, note that the commentaries

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[17] See (Shukla and Sharma 1976, xxv–lviii). We have included Prabhākara in this account, although no extant commentary is known. Nonetheless, he is quoted by Bhāskara.

[18] CESS IV 255 b; V 239 b.

[19] See (Shukla and Sharma, 1976), (M. S. Dvivedin, 1902), (Hayashi, 1995), (K. S. Shukla, 1959), and (Rangacarya 1912). There have been numerous printed editions of L and BG, two texts which are noted in CESS 4 308 a and 311 b. See the translation given in (Brahmagupta; Bhāskarācārya; Colebrooke 1817).

[20] The text of T was edited in (Dvivedin 1899). The text of GT was edited with a modern commentary (kāpadīā 1937). The text of MS was edited by Sudhākara Dvivedin in 1910 (S. Dvivedin, 1910), and partially translated into English by S. R. Sarma, (Sarma 1966).

[21] The mathematical part is sometimes translated in (Colebrooke 1817)'s footnotes. Part of PBSS's astronomical commentary has been studied, edited and translated by Setsuro Ikeyama (Ikeyama, 2003). Pṛthudakṣvamin's commentary on the twelfth chapter of the BSS, is found in a manuscript at the Indian Office and in what appears as a copy of this manuscript used by S. Dvivedi in Benares (CESS A. IV. 221 b), (Ikeyama, 2003, S5–7). This last commentary has not been edited entirely, probably because the only recension is at times quite difficult to understand.

[22] (Shukla 1976).

Fig. 2 Edited and translated texts on mathematics from the fifth to the twelfth century

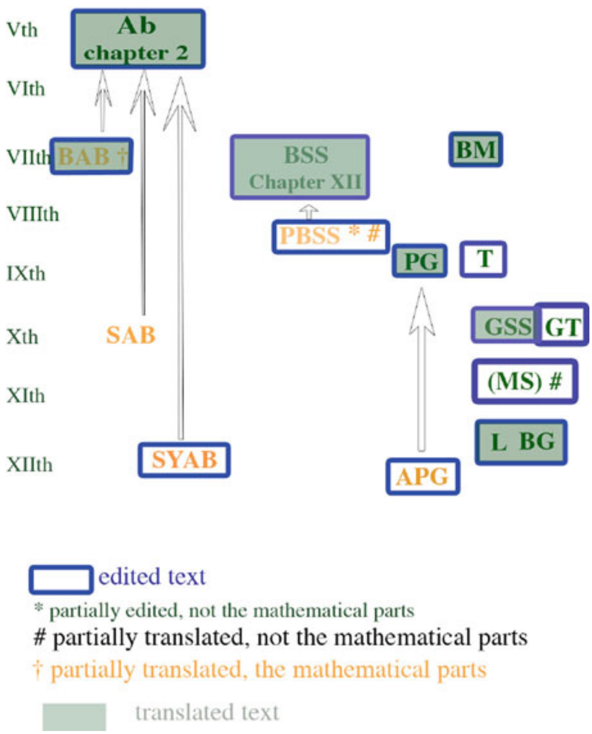


Table 2 Editorial situation of texts on Sanskrit mathematics from the fifth to twelfth century

Abbreviation	Treatise, commentary, others	Edited	Translated
Ab	Versified treatise	Yes	Yes
BSS	Versified treatise	Partly	Partly
BAB	Prose commentary	Yes	Partly
BM	Fragmentary text (versified rules and examples; prose resolutions)	Yes	Yes
PBSS	commentary	Partly	Partly
PG	Versified treatise	Yes	Yes
T	Treatise	Yes	No
GSS	Treatise	Yes	Yes
GT	Treatise	Yes	Partly (not the mathematical parts)
L	Treatise	Yes	Yes
BG	Treatise	Yes	Yes
MS	Treatise	Yes	Partly
SYAB	Commentary	Yes	No
APG	Commentary	Yes	No

have been generally edited, but usually not translated: a striking artefact of modern scholarship.

This editorial situation can be taken as a symptom of the special treatment of commentaries as independent texts. The situation raises many questions: Were commentaries less frequently translated because historians of science were not interested in them? Or was their neglect a consequence of the state of manuscripts? These questions lead us to consider the way ancient collectors of texts, and maybe even authors of commentaries themselves, regarded the texts they were composing.

Reading and Collecting Commentaries on Mathematical Subjects

Who collected manuscripts? Who had them made? Who copied them? As C. Minkowski and D. Raina's articles in this volume emphasize, to date we have only sporadic information, which enables only partial answers, varying from library to library, region to region, collection to collection. Because we have restricted ourselves to a specific corpus, information is especially sparse. Usually, we do not even know the dates of manuscripts or their accession histories, but it is reasonable to believe that they are mostly products of the copying frenzy during the late modern period described by C. Minkowski in his article of this volume.

In certain cases, a great number of ancient hand made copies of a given text have been preserved. Thus, for Ab,[23] the CESS counts 149 manuscripts of which 47 (more or less 1/3rd) include commentaries. These manuscripts can be found in 28 different libraries. These texts are mostly of unknown origin and are written on either paper or palm leaf.

The extant manuscripts of commentaries are comparatively less important. Bhāskara's commentary is known through six manuscripts, five of which are in the same library in Kerala. All are incomplete.[24] Similarly, Sūryadeva's commentary has been transmitted to us through eight south Indian recensions and copies,[25] while SAB is known through only one copy.[26] The BSS is known through 34 manuscripts[27] and PBSS is known in seven manuscripts, two of which are fairly recent copies of two others, none of which are extant.[28] Only two of these seven manuscripts contain the commentary on chapter XII which is explicitly devoted to *gaṇita*.[29] Finally, the edited PG is known through one

[23] CESS 1 51a–52b; 2 15b; 3 16a; 4 27b.

[24] (Shukla 1976), CESS IV 297b.

[25] (Sarma 1976, xvii–xxv).

[26] (Sen et al. 1966, 202), CESS I-II 51a.

[27] CESS IV 254 b-255b, CESS V 239 b-240 a.

[28] CESS IV 221 a, CESS V 224 a .

[29] (Ikeyama 2003, p. S7).

Table 3 Number of manuscripts for commentaries and treatises on mathematics from the fifth to twelfth century

Text	Treatise	Commentary	Number of remaining manuscripts
Ab	x		47
BAB		x	6
SAB		x	1
BSS	x		24
PBSS		x	7
PG	x		1
APG		x	1

manuscript – the same one containing APG.[30] These details are summarized in Table 3.

Therefore, in these collections, commentaries were much less numerous than the treatises and even then the commentaries were not always complete. Is this scarcity due to the hazards of preservation, or does it reflect a set of assumptions about the commentaries in common currency when the texts were copied or collected during the eighteenth and nineteenth centuries? Did the authors of commentaries themselves consider their commentaries fragmentary texts? Do these assumptions explain the way commentaries were subsequently treated by historians? To answer these questions precisely, we must inquire more deeply into the complexities of each text and how it has been transmitted to us. However, before looking at how these commentaries were transmitted, let us specify what kind of texts are subject to this analysis.

A Preliminary Characterization of Commentaries on Mathematics

As is clear from this article, much work stills needs to be done in organizing and categorizing the corpus of Sanskrit manuscripts. Consequently, there is something tricky in any attempt to isolate and identify mathematical commentaries among the other Sanskrit texts on mathematics and related subjects. Nonetheless, some useful but tentative conclusions may be derived.

The titles of texts and expressions used in them indicate that the Sanskrit scholarly tradition distinguished between treatises (*śāstra* , *tantra*, *siddhānta*) and commentaries (*vyakhyā*, *bhāṣya*, *ṭīkā*).[31] A similar distinction separated the fields of *jyotiṣa* and *gaṇita*.[32] Many other kinds of texts occupied these fields, such as

[30] (Shukla 1959). As noted previously, (Sen et al. 1966, 204) notes a second manuscript of the PG *ṭīkā*, incomplete at 54 folios, in the Descriptive Catalogue of the Oriental Mss in the Mackenzie Collection, compiled by H. H. Wilson in Madras in 1882.

[31] For an attempt to characterize "scholastic Sanskrit" of commentaries (in the case of grammatical, philosophical and logical texts), see (Tubb 2007).

[32] In the case of commentaries, many different technical names are recorded either in the titles or by D. Pingree in the CESS. Keeping in mind that these numbers and percentages should be

handbooks for making calendars (*karaṇa*), almanacs (*pañcāṅga*), compendiums (*nibandha*), etc.[33] With this wealth of titles in mind, we can ponder whether certain kinds of text had been preferred over others in times past. Did such preferences vary over time, in different places, or according to certain sub-fields? Do these trends tell us something about the conceptions which different actors had of what an astronomical or mathematical text ought to be? What do these trends indicate about how such disciplines were practiced? Did the historians of science who identified these texts focus on one kind of text over another?

Concerning texts composed between the fifth and twelfth centuries, the Ab is referred to as a *tantra* by Bhāskara[34] but is described as a *śāstra* by Sūryadeva Yajvan. Finally, APG refers to the text for which it provides commentary as a *śāstra*.[35] Similarly, the Sanskrit authors rely on a paucity of names to title to their commentaries. Thus, Bhāskara calls his commentary a *vyākhyā*.[36] Bhāskara's subsequent tradition, as noted in the title of his commentary, refers to his text as a *bhāṣya*. Sūryadeva Yajvan occasionally refers to his own text as a *vyākhyā*, but more generally, he calls it a *prakāśa*, "light".[37] Finally, the APG simply calls itself a *ṭīkā*.[38] We do not know then if these titles and names are

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used cautiously, the initial results may be reported. First, *ṭīkā*s compose 549 titles, (67.2% of all commentaries), but other technical names and titles appear. *Vyākhyā*s represent 85 titles (or 10.4%); *vivṛtti*s number 50 (or, 6.1%); and *bhāṣya*s number 34 (or, 4.1%). Smaller numbers of *avacūrṇi*s, *vārtikka*s, *tippaṇaṇi*s, and *vivāraṇa*s also occur. This diversity raises the general question of how the texts were titled. Unlike the compositions examined by C. Minkowski, the names of patrons seldom appear here. Moreover, were the titles composed by authors or by later scholars? Is it possible that the titles were modified by those who copied texts? These questions can be extended to all texts in the census. I count only 205 texts (or, 5.5%) with *siddhānta* in the title. Likewise, only 18 are described as *śāstra*s and *tantra*s. In 141 cases (or, 3.8%), the titles (*saṅgraha*, *jñana*) express the fact that the compositions bestow knowledge; in 118 cases (or, 3.2%), the titles (*phala, sāra*) convey the idea of providing an essence of something. Sometimes the titles indicate both of these concerns: (*sārasaṅgraha* is quite a common title compound). The metaphor of light (*dīpika*, *prakāśa*) occurs 289 times (or, 7.8%) and somewhat less frequently in the titles of 28 commentaries (or, 3.4%).

[33] (Pingree 1981). I have counted in the CESS 130 texts (or, 3.5%) bearing the name *karaṇa* or some associated title and 66 almanacs (or, 1.7%) bearing the name(*pačāṇgas*) or texts explaining how to make almanacs. The CESS further notes a number of non-standard texts, such as the *Aparājitapṛcchā* of Bhuvanadeva (fl. twelfth century), a text on architecture written as a dialogue (CESS V 264 a.).

[34] To be more specific, the three last chapters of the *Āryabhaṭīya* are discussed in this way in the conclusions of the commentaries to each of these chapters. (Sarma 1976, xxv), (Shukla 1976, 171, 239, 288).

[35] (Shukla 1959, 1).

[36] See the *maṅgalācaraṇam* of BAB.2 : *vyākhyānaṃ gurupādalabdham adhunā kiñcin mayā likhyate*, (Shukla 1976, 43).

[37] Thus, at the end of the introduction which begins his commentary, Yajvan writes *evam upodghātaṃ pradarśya śastraṃ vyākhyāyate*. (Sarma 1976, 7) However, at the end of that chapter's commentary, he refers to his own text as a *prakāśa*. (Sarma 1976, 32, 79 (note 11), 117, 185). Again, at the end of SYAB.2, Yajvan relies on the verbal root *vyākh-*.

[38] (Shukla 1959, 1).

simply synonyms or if they were intended to impart something about the kind of commentary which the authors and readers had in mind when they named them.

A commentary, by definition, is a secondary text, a deuteronomic text, a text that needs another text to make any sense.[39] However, is this definition sufficient to characterize a text? Sanskrit have a multiplicity of forms. This diversity is reflected somewhat in the Sanskrit field of mathematics. Some commentaries respect the original order of the text, while others do not.[40] In particular, BAB, SAB, SYAB and APG[41] respect the structure of the original text, whereas PBSS does not.[42] Alternately, SYAB develops a long introduction (*upodghata*) before the first gloss of the text, but this is not the case in the other commentaries considered here. Even though all commentaries have in common the use of a base text, the way they provide commentary varies widely. Thus, the relation between the commentary and the treatise which it elucidates must be specified.

All commentaries considered here quote the text which they purport to explain in its entirety.[43] Despite the obvious embedding of the original text, finding stylistic criteria which separate the commentaries from the treatises proves to be a difficult task. Almost as soon as a principle of separation is proposed, a counter-example can be identified. Manuscripts, did not always graphically distinguish treatises from their commentaries. For instance, consider the illustration in Fig. 3. Here, the treatise appears to be an undifferentiated part of the commentary.

In other cases, such as in Fig. 4, the part of the original text which received commentary was colored differently or graphically separated from the commentary, but this was not a systematical rule.[44]

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[39] On the question of "secondary texts" in the history of mathematics, see (Netz 1998), (Chemla 1999), (Bernard 2003) and also Chemla in this volume.

[40] See (Bronkhorst 1990).

[41] One should recall however that PG, given in Shukla's edition, is known only from this single recension (Shukla 1959).

[42] According to CESS IV 221b, the text of PBSS corresponds to I.1–3, XXI.1–XXII.3, I.4–II.68, XV.1–9, III.1–XIV.55, XV.1à–XX.19, and XXII.4–XXIV.13, respectively, with chapters denoted by roman numerals and sections within chapter indicated by arabic numerals. It remains to be clarified what logic directed the composition of PBSS in this order.

[43] However, they also all quote other texts, albeit not completely. Thus, SYAB often quotes PG, and APG cites BSS. SYAB frequently paraphrases BAB. Therefore, commentaries may be described as composite texts, assembled from parts of previously composed texts which are sometimes rewritten or paraphrased, and intertwined with passages original to the commentary. The commentaries also frequently share versified examples and these can be considered a form of quotation as well.

[44] Perhaps this standard arose in modern (eighteenth-nineteenth century) scribal traditions, and may very well have its ultimate origin in practices introduced by European texts, or as suggested in (Plofker 2009, A.3, 305) by Islamic ones.

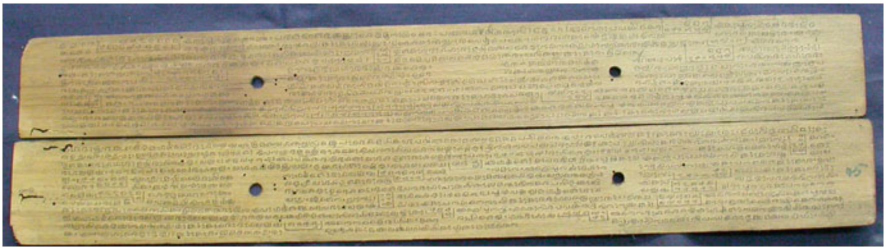


Fig. 3 Palm leaf manuscript of BAB in a copy of the Kerala University Oriental Manuscripts Library

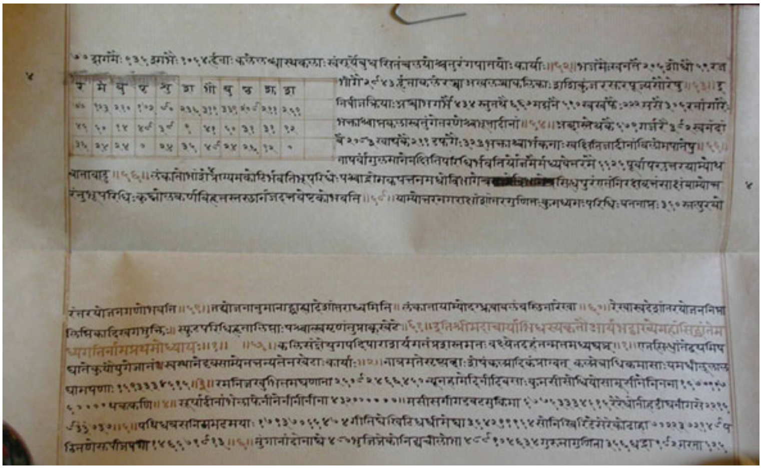


Fig. 4 Paper manuscript with colored highlights of MS in a copy of the Mumbai University Library

Thus, even though the titles suggest a difference, the material culture does not always preserve such a standard. Does this indicate that copied texts were not intended to be read? A historical study of traditions of reading and copying in the Indian subcontinent could shed much needed light on the practice of composing commentaries.[45]

The distinction between treatises and commentaries has often been described as a written reflection of the oral tradition, wherein some portion of the text was

[45] Note also that a strong stylistic criteria which separates commentaries from treatises would help philologists who edit manuscripts to determine what portion belongs to the original text and what portion belongs to the commentary.

known by heart (the treatise) and some portion contained the explanations that were given subsequently (the commentary). Whereas the treatise was essentially an oral composition, the commentary was largely a written text.[46] This distinction derives from the words of the commentators themselves. Thus, Bhāskara insists on a distinction between Āryabhaṭa who produced the treatise orally (*āh*-), and Bhāskara's own commentary which he committed to writing (*likh*-). Conversely, though, Hayashi has shown that the word *likh*- (to write) may occur as a synonym for *vac*- (to speak) in the BM.[47] In this case, there appears to be no difference between a written text and an oral one.

Not even the distinction between verse and prose passes unchallenged. Indeed, the treatises here are all versified. Thus, Chapter 2 of the AB, chapter XII of the BSS, and the PG are composed as *ārya* verses. The commentaries all include prose sections, which can present great variation : for instance, they can introduce dialogs or grammatical analysis, but they all include versified parts. Thus, BAB even contains versified tables. Likewise, all commentaries contain versified examples.[48]

The presence of worked examples, together with the fact that they contain non-discursive parts such as numerical tables and drawings, may be a defining characteristic of mathematical commentaries in Sanskrit. Only further systematic study of the features of Sanskrit commentaries–especially of Sanskrit commentaries in the field of *jyotiṣa*–will provide additional elements. Despite these possible defining features, the characteristics of treatises and commentaries remain a complex and difficult question, both in Sanskrit literature generally as well as in the limited case of mathematical commentaries.[49]

Internal evidence may yet reveal something about how texts were understood in relation to one another. Questioning why and how texts were copied may also yield some as yet unconsidered kinds of evidence and provide clues to the historical evolution of the social conceptualization of such texts. The history of text copying, collection and reading additionally gives us contextual information on who had texts collected and copied, as we will now see.

An Example: Manuscripts of SYAB

K. V. Sarma has described the codex in which the SYAB was found in Kerala.[50] In an Indological context, "codex"' refers to the bundle of texts which may

[46] See, for instance, (Shukla 1976, Introduction).

[47] (Hayashi 1995, 85).

[48] In his edition of PG and APG, Shukla seems hesitant: are the examples part of the treatise or part of the commentary? All editions of L consider examples part of the treatise.

[49] In several parts of her book, (Plofker 2009) offers several rough characteristics of mathematical commentaries: their uses of proofs and language games essentially.

[50] (Sarma 1976, Introduction, xvii–xx).

sometimes comprise several texts. These bundles are an indication that the texts were either copied together or had been collected at the time they were integrated in the library. The first codex under consideration contains a set of manuscripts which represent part of a collection made by scholarly astronomers.

Some historical details are known about Codex C. 224-A, the codex containing Manuscript A. This codex was made for the royal family of Eḍapaḷḷī of Kerala, in 1753. Aside from Manuscript A, it also contained six other texts: two early works by Bhāskara I (seventh century): the *Laghubhāskarīya* and *Mahābhāskarīya*; two tenth-century works, the *Sūryasiddhānta* and the *Siddhāntaśekhara* of Śrīpati (fl. 1050). Finally, two fourteenth century compositions, the *Goladīpikā* of Parameśvara and the *Tantrasaṇgraha* of Nīlakaṇṭha Somayājin (fl. 1450) round out the codex. Although they represent nearly eight hundred years of intellectual tradition, all these texts share a common subject matter: astronomy. In a similar way, manuscript D, also originated from a codex, (C. 22475-A). This codex belonged to the same royal family of Kerala and contains both SYAB and the solitary first chapter of Ab.

Again, Manuscript E of the same edition belonged to a codex (C.2121 C and D) which originally came from the "library of a family of astronomical scholars, the Maṇgalappaḷḷī Illam, at Āranmuḷa, in southern Kerala".[51] Aside from the SYAB, this codex contained nine compositions. The earliest text contained by the codex are the last three chapters of Ab. Next, chronologically came the *Mahābhāskarīya* of Bhāskara I and its anonymous commentary, the *Mahābhāskarīyavyakhyā*. Likewise, the codex also contains the *Laghumānasakaraṇa* of Muñjāla (fl. 932) and its anonymous commentary. It includes T, and while only the commentary to chapter II and parts of chapter III of the *Sūryasiddhānta* appear, the codex preserves the whole of the *Sūryasiddhānta*. Finally, the codex contains an anonymous prose *Rāmāyaṇa*. Setting aside the prose version of the famous Indian Epic, this codex also concentrates on astronomical and mathematical lore. Here, only part of a commentary on the *Sūryasiddhānta* is copied but the treatise itself is extensively copied. Ab is known to have been transmitted in two separate parts: the first chapter was copied separately (as in the codex for Manuscript A) from the 3 other parts (as in the codex of Manuscript E).

Evidently, commentaries were not exclusively copied together with other commentaries. Rather, a codex could contain a treatise by itself, and a couple chapters of commentary by a given author. Unlike the Chinese tradition, texts of important treatises could be copied and collected without any commentaries. Different commentaries to the same text were usually copied separately, unlike the tradition of the Chinese *Nine Chapters*.

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[51] (Sarma 1976, Introduction, xix)

Another codex, C. 2320-A, sheds light on texts copied for another kind of social context: the *nampūtiri*, the brahmin cast of Kerala whose priests follow Vedic rituals, (*śrauta*). Of course, this codex contains SYAB, but it also contains a text describing the horse sacrifice and detailed accounts of expenses for a ceremony carried out in 1535. The codex itself seems to be a copy of a manuscript dating from 1536. This textual justification finds some historical precedent. Sūryadeva, himself a performer of Vedic rituals, understood Āryabhaṭa's text in relation to the *śrauta*.[52] Save for the *siddhāntic* text, this small codex corresponds to the kind of *śrauta* collection which C. Minkowski describes for the Toro family. Might the surprising inclusion of the *siddhāntic* text indicate that the use of *siddhāntic* astronomy was a common phenomenon among ritualist families?

Manuscript B of Sarma's edition was preserved by a scholarly family from *vaṭṭapaḷḷi maṭham* (a religious complex) near *kanyākumārī* (the southernmost tip of the Indian sub-continent), in Tamil Nadu. Along with the *Bhaṭaprakāśikā* (SYAB), the codex contains an *Āṣṭādhyāyī-sūtrānukramaṇi*, an alphabetical index of Pāṇini's *sūtras*. In this way, the codex sets grammatical lore alongside mathematical learning.[53] In this case, the motive for the inclusion of SYAB with literary elements seems to have been the result of an endeavor to collect general Sanskrit scholarship.

The provenance of these manuscripts, then, underscores the already well-known legacy of *Āryabhaṭa* in Kerala. The SYAB seems to have been used in three different, although probably not separate, social contexts. The SYAB appears among scholarly astronomers, among priests who perform Vedic rituals and among the general scholarly atmosphere of south Indians monasteries.

Nonetheless, little information about how these texts were integrated into the Kerala University Oriental Manuscript Library where they are now can be found. Originally created by the Government of Travencore, an autonomous state within the British Raj, since 1908 the library has taken as its mission the the preservation of local heritage.[54] The history of this library calls for further investigation, but for now, let it suffice that the structure of the collection in which different codices containing SYAB are found recalls those C. Minkowski has described.

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[52] Oddly, SYAB states this clearly in its general introduction to Ab (Sarma 1976, xxv–xxvi, 2–4). Āryabhaṭa can scarcely be considered a ritualist, given the fame he garnered for taking puranic cosmology lightly.

[53] (Sarma 1976, xviii).

[54] The "Index of Manuscripts" of the library notes that "In 1940 it possessed 3000 manuscripts, 142 publications in Sanskrit, 63 in Malayalam. Travancore University (which became the University of Kerala) organized after its establishment (1938) a manuscript preservation and collection department. Both were amalgamated in 1940. In 1958 there was (sic) 28 000 Codices in Sanskrit; 5 000 in Malayalam."

The manuscripts of other mathematical texts do not always provide as rich information as the manuscripts of SYAB. For example, the BAB manuscripts preserved at the KUOML are not preserved within a codex. Similarly, the extant manuscripts of the PBSS tell us more about their recent accessions than about the tradition which transmitted them. To wit, the two manuscripts which contain chapter XII of the PBSS: one served as the text for the Colebrooke translation and the other served as the source for the edition which S. Dvivedin made in Benares.[55]

As might be expected, treatises on mathematics have attracted more attention, study and attempts at translation than have commentaries on mathematical treatises. Notwithstanding this fact, mathematics as a discipline has attracted far more scholarship in the last two centuries than other elements of *jyotiṣa* lore. Criteria to differentiate commentaries from treatises and tools to understand how the two types of texts relate to each other have been difficult to find. This relationship is complicated by the fact that each individual text seems to have a unique story of preservation and transmission. In the early modern period in South India, royal families with an interest in astronomy, ritualist families and religious groups had texts on mathematics copied. Those who copied the commentaries to those mathematical texts could copy them only partially. They seem not to have considered commentaries as independent extant texts. However, the question has not been addressed whether the authors of the commentaries considered their compositions independent texts? Were treatises even considered in this light? Furthermore, it is not certain how much the attitude of early modern copiers informed (or reciprocally was informed by) the practices and interpretations of the Europeans who read these texts at the end of the eighteenth century and the beginning of the nineteenth century.

The Rediscovery of Ab, BSS, PG and Their Commentaries in the Historiography of Indian Mathematics

Now that an understanding of the textual traditions of Sanskrit mathematical texts, their commentaries, and the problems related to these categories has been made, the textual aspects which informed the writing of the mathematical history of India may be reconsidered. Many of the questions depend on the assumptions and conceptions of past historians: How have historians of mathematics looked at the Ab, the BSS and the PG and their commentaries written between the seventh and twelfth centuries? There is no simple trend or common understanding which unifies how different historians dealt with commentaries. However, a key difference in perspective may lie in whether the historians were mathematicians or philologists. The more strongly the historian identified as a mathematician, the less sensitivity he or she generally exhibited toward textual

[55] See (Pingree 1970–95, op.cit), (Ikeyama 2003, op.cit) and (Dvivedin 1902).

problems; conversely, the more strongly he or she followed in the tradition of philologists, the greater weight he or she tended to ascribe to the commentary. Because of individual variation, however, this does not mean that commentaries were always treated as secondary texts by mathematicians but deemed important sources by philologists. As the twentieth century came to a close, the general historiographical trend has been to pay more and more attention to the mathematical contents of commentaries. We cannot afford here to look closely at the shifting attitudes of all historians, but we will try to draw out some of the characteristic attitudes which Colebrooke, Datta & Sing, and K. S. Shukla exhibited toward commentaries.

As D. Raina's article in this volume explains,[56] by the early seventeenth century, a number of Europeans knew of the existence of Sanskrit astronomical treatises through the testimonies of travelers, academic envoys, and Jesuit missionaries. Some time passed before curious Europeans were able to obtain these texts and study them. By the early nineteenth century, the first translations of Sanskrit texts on mathematics into European languages (especially English) had been made. Thus, in 1812, in London, Stratchey produced the first translation of the BG into English. Next, in 1816, Taylor translated the BG in Mumbai. Finally, Colebrooke translated L and BG together with the mathematical chapters of Brahmagupta's BSS and published the results in London in 1817.[57]

Colebrooke and Commentaries

Colebrooke's publication proved to be a landmark. A former director of the Asiatic Society of Bengal and a recognized specialist of Hindu Law, Vedic ritual and Indian languages, Colebrooke had solid credentials. His publication marked the first interest of a well-established Indologist in mathematical texts from the Indian subcontinent. Colebrooke prefaced his translations of mathematical texts with a general "dissertation", followed by "notes and illustrations", which intended to establish these texts against the general history of mathematics. In this way, he endeavored to establish India among the ranks of mathematical cultures, a status which until then it had lacked.[58] In his introduction, Colebrooke takes a strong position on the antiquity of the Indian tradition of mathematics, especially algebra. In so doing, Colebrooke raised the stakes in an ongoing controversy about the age of Indian mathematics.[59] Through the high quality of his translations, generally made in close

[56] See also Raina (1999, 2003).

[57] (Brahmagupta; Bhāskarācārya; Colebrooke, 1817).

[58] *Op.cit.*; p. xvi.

[59] (Kejariwal 1988, 111–112).

collaboration with pandits, Colebrooke established his publication as an enduring reference.

Colebrooke included portions of commentaries in the footnotes to his translations. Thus, Colebrooke included parts of the commentaries of Gaṇgadhāra (fl. 1420), Sūryadasa (1541), Gaṇeṣa (fl.1520/1554), and Ramakṛṣṇa's (1687?[60]) in his translation of L[61]'s translation; when Colebrooke translated BG, he incorporated passages from the commentaries of Kṛṣṇa (ca.1615), Rangunāṭha (dates unknown), and Ramakṛṣṇa. Finally, when Colebrooke prepared a translation of the BSS, he used (and quoted) the PBSS, which he cited as "CA", an abbreviation of *Caturdeva*, part of the name of the author of the commentary. Furthermore, although neither he nor his readers had recourse to the original text, Colebrooke refers to and discusses Āryabhaṭa's works in his introduction.[62] In so doing, Colebrooke passed along second-hand references: Āryabhaṭa was indeed criticized by Brahmagupta and a diverse group of commentators quoted and discussed Āryabhaṭa's verses. Colebrooke also referred to a work by Śrīdhara, though not however our PG[63]. Thus, Colebrooke introduced his readers to Āryabhaṭa, Brahmagupta and Śrīdhara.

Colebrooke hoped to describe the mathematical tradition of India. This aspiration limited his interest to only the mathematical part of Brahmagupta's treatise, the BSS, and, consequently, only a portion of PBSS. The possibility that Colebrooke may have adopted his limited interest from the known tradition of copying (and thus showing a specialized interest in) only the mathematical chapters of astronomical treatises of the Sanskrit tradition prompts speculation. Just as Colebrooke may have continued past traditions, he may have founded others. The collation of BSS's chapters into a printed edition may also mark the beginning of an enduring historiographical trend noted in the introduction: among the old *jyotiṣa* texts, mathematical subjects have been the subject of more study than astronomy or astrology.

In his introduction, Colebrooke presents the writing of the commentators as proofs of the authenticity and antiquity of the texts he is translating and discussing. As Colebrooke writes[64]:

> The genuineness of the text is established with no less certainty [than its date] by numerous commentaries in Sanskrit, besides a Persian version of it. Those commentaries comprise a perpetual gloss, in which every passage of the original is noticed and interpreted : and every word of it is repeated and explained, a comparison of them authenticates the text where they agree; and would serve, where they did not, to detect any alterations of it that might have taken place, or variations, if any had crept in, subsequent to the composition of the earliest of them. A careful collation of several

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[60] CESS V 453 a.

[61] *Op.cit.* Note A p. xxv and p.xxvii

[62] *Op.cit.* Introduction, sections G to I pp. xxxvii–xiv.

[63] *Op.cit.* p.v Colebrooke writes that he has a copy of "Srídhara's compendium of arithmetic", which is probably the *Triśatika*.

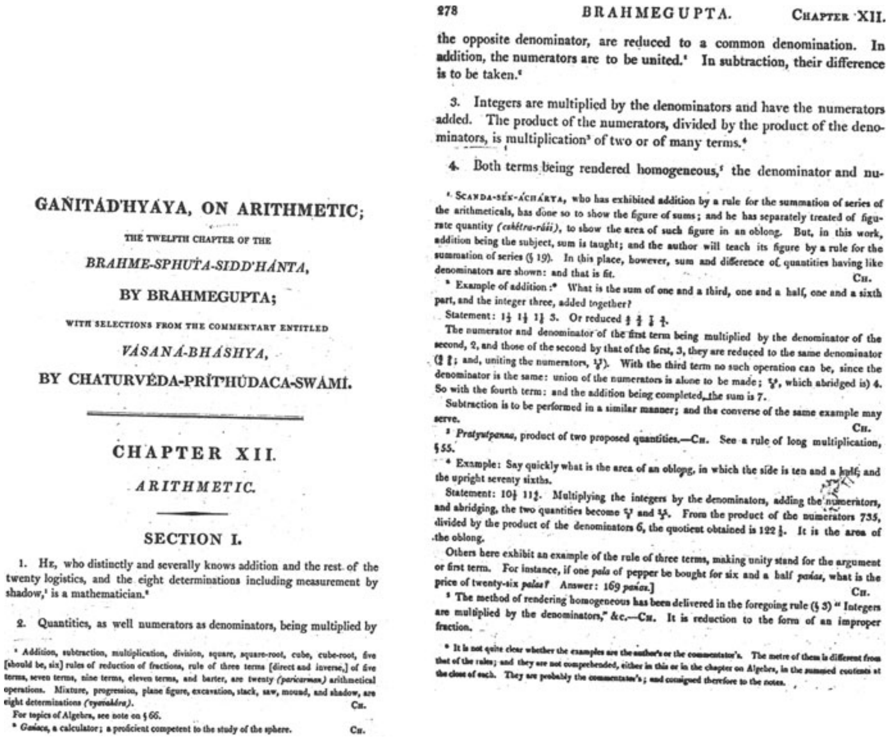
[64] (Brahmagupta; Bhāskarācārya; Colebrooke 1817, iii)

commentaries, and of three copies of the original work, has been made, and it will be seen in the notes to the translation how unimportant are the discrepancies.

For Colebrooke, commentaries are thus useful and necessary in order to edit a text: they are philological tools. However, the way the commentaries are integrated in his translations reveals that he considered them far more than mere tools. Commentaries were key to understanding the treatises. They were stimulating mathematically with their examples and proofs. However, the commentary was not treated as a text in and of itself. It was given in bits and pieces. Selected.

Consider the translation, as seen in Fig. 5. Typographically, the commentary is a secondary text, written in a smaller font. The commentary is fragmentary, relegated to and divided among different footnotes. Despite its status as a secondary text, Colebrooke makes the importance he ascribes to the commentary visually explicit. In Colebrooke's edition, the commentary literally spills over and invades the space which is meant for the treatise.

If we recall that the codices sometimes include only portions of the commentaries, we may wonder how much of Colebrooke's attitude toward giving commentaries in bits and pieces reflects the training he received from pandits.



GAṄITÁD'HYÁYA, ON ARITHMETIC;

THE TWELFTH CHAPTER OF THE

BRAHME-SPHUṬA-SIDD'HÁNTA,

BY BRAHMEGUPTA;

WITH SELECTIONS FROM THE COMMENTARY ENTITLED

VÁSANÁ-BHÁSHYA,

BY CHATURVÉDA-PRÍT'HÚDACA-SWÁMÍ.

CHAPTER XII.

ARITHMETIC.

SECTION I.

1. He, who distinctly and severally knows addition and the rest of the twenty logistics, and the eight determinations including measurement by shadow,[1] is a mathematician.[2]

2. Quantities, as well numerators as denominators, being multiplied by

[1] Addition, subtraction, multiplication, division, square, square-root, cube, cube-root, five [should be, six] rules of reduction of fractions, rule of three terms [direct and inverse,] of five terms, seven terms, nine terms, eleven terms, and barter, are twenty *(paricarman)* arithmetical operations. Mixture, progression, plane figure, excavation, stack, saw, mound, and shadow, are eight determinations *(vyavahára)*. CH.

For topics of Algebra, see note on § 66.

[2] *Gaṅaca*, a calculator; a proficient competent to the study of the sphere. CH.

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the opposite denominator, are reduced to a common denomination. In addition, the numerators are to be united.[1] In subtraction, their difference is to be taken.[2]

3. Integers are multiplied by the denominators and have the numerators added. The product of the numerators, divided by the product of the denominators, is multiplication[3] of two or of many terms.[4]

4. Both terms being rendered homogeneous,[5] the denominator and nu-

[1] SCANDA-SÉNA-ÁCHÁRYA, who has exhibited addition by a rule for the summation of series of the arithmeticals, has done so to show the figure of sums; and he has separately treated of figurate quantity *(cshétra-rási)*, to show the area of such figure in an oblong. But, in this work, addition being the subject, sum is taught; and the author will teach its figure by a rule for the summation of series (§ 19). In this place, however, sum and difference of quantities having like denominators are shown: and that is fit. CH.

[2] Example of addition:* What is the sum of one and a third, one and a half, one and a sixth part, and the integer three, added together?

Statement: $1\frac{1}{3}$ $1\frac{1}{2}$ $1\frac{1}{6}$ 3. Or reduced $\frac{4}{3}$ $\frac{3}{2}$ $\frac{7}{6}$ $\frac{3}{1}$.

The numerator and denominator of the first term being multiplied by the denominator of the second, 2, and those of the second by that of the first, 3, they are reduced to the same denominator ($\frac{8}{6}$ $\frac{9}{6}$; and, uniting the numerators, $\frac{17}{6}$). With the third term no such operation can be, since the denominator is the same: union of the numerators is alone to be made; $\frac{24}{6}$, which abridged is) 4. So with the fourth term: and the addition being completed, the sum is 7.

Subtraction is to be performed in a similar manner; and the converse of the same example may serve. CH.

[3] *Pratyutpanna*, product of two proposed quantities.—CH. See a rule of long multiplication, § 55.

[4] Example: Say quickly what is the area of an oblong, in which the side is ten and a half; and the upright seventy sixths.

Statement: $10\frac{1}{2}$ $11\frac{2}{3}$. Multiplying the integers by the denominators, adding the numerators, and abridging, the two quantities become $\frac{21}{2}$ and $\frac{35}{3}$. From the product of the numerators 735, divided by the product of the denominators 6, the quotient obtained is $122\frac{1}{2}$. It is the area of the oblong.

Others here exhibit an example of the rule of three terms, making unity stand for the argument or first term. For instance, if one *pala* of pepper be bought for six and a half *paṅas*, what is the price of twenty-six *palas*? Answer: 169 *paṅas*.] CH.

[5] The method of rendering homogeneous has been delivered in the foregoing rule (§ 3) "Integers are multiplied by the denominators," &c.—CH. It is reduction to the form of an improper fraction.

* It is not quite clear whether the examples are the author's or the commentator's. The metre of them is different from that of the rules; and they are not comprehended, either in this or in the chapter on Algebra, in the summed contents at the close of each. They are probably the commentator's; and consigned therefore to the notes.

Fig. 5 The BSS and PBSS in Colebrooke's translation

Perhaps the pandits themselves worked in this way and helped Colebrooke understand the text through collating references in different commentaries. Here, a history of how commentaries were conceptualized and read in the Indian subcontinent would be helpful. Likewise, a precise description of how Colebrooke (and other European scholars) worked with pandits in relation to texts would be useful as well.[65]

Indian Scholarship with Commentaries: Datta and Singh and K. S. Shukla

During the nineteenth century, the academic history of mathematics in India slowly opened to Indian scholars, who expounded a scholarship as much directed toward an inner audience as toward answering European interlocutors and engaging them in discussion.[66] The arrival of Indian scholars may first be perceived from articles discussing authorship of texts and was later placed in evidence by series of editions and translations of texts on mathematics. The names Datta, Sengupta and Dvivedin first appear during a period when European scholars had confused the fifth century Āryabhaṭa with his eleventh century namesake, and mistaken the seventh century Bhāskara I with his twelfth century namesake.

By the end of the nineteenth century, the movement of edition, translation and analysis of texts on mathematics in Sanskrit, which had begun at the turn of the previous century, came to a peak. In 1874,[67] Kern edited the Ab for the first time.[68] Kern printed his edition with the commentary of Parameśvara (fourteenth century). Kern's introduction cites SYAB, which is quoted by Parameśvara, but no reference is made to BAB. In 1879, Leon Rodet translated chapter 2 of the Ab into French and conducted an analysis of the text.[69] In 1896, Dikshit edited the BSS together with his own commentary.[70] These two editions were followed by a number of translations in English, which in turn prompted the first studies in this language. Thus, in 1907 and 1908, G. R. Kaye published his controversial work, *Notes on Indian Mathematics*, part two of which is devoted to Āryabhaṭa.[71] Sengupta published the first English translation of the Ab,[72]

[65] The latter has been partially studied in (Kejariwal 1988), (Aklujkar 2001), (Bayly 1996) among others, but little seems to have survived on precisely how European scholars and the pandits worked texts out.

[66] (Keller 2006b).

[67] (Kern 1874).

[68] The tradition of copying manuscripts can, of course, also be understood as the editorial tradition of classical India, but printed books are referred to here.

[69] (Rodet 1879)

[70] (Dikshit 1896).

[71] (Kaye 1908).

[72] (Sengupta 1927).

followed by Clark in 1930.[73] In 1937, B. Datta and S. N. Singh published the enduring classic "Hindu Mathematics".[74] They aimed to provide a general description of all the variations by which Hindu mathematicians practiced elementary and sometimes higher mathematics, each Sanskrit author contributing elements of his own expertise. Datta & Singh also wanted to refute G. R. Kaye's claims for an Arabic or European origin of Indian mathematics generally and his attribution of the mathematics in Ab to a foreign source specifically. In order to accomplish these ends, they dedicated part of their effort to the comparison of the history of mathematics in Europe with what had been discovered about the history of mathematics on the Indian subcontinent. To a certain extent, Datta & Singh also wrote a history of mathematics in India in praise of its great mathematicians and the important discoveries recorded in their treatises. As trained mathematicians, Datta and Singh largely focused on the mathematical contents of the texts.[75] Throughout their publications, B. Datta and A. N. Singh essentially consider mathematical commentaries to be mathematical texts. In this context, they occasionally referred to Bhāskara I, whose text was known but was not published, as an astronomer who dealt with mathematics.[76] Datta & Singh sometimes quoted Bhāskara I's commentary to explain or interpret the verses in Ab.[77] Occasionally, they seem to share Colebrooke's model and relegate these citations to footnotes on the text.[78] Datta & Singh often collated these citations with other commentaries on Ab, such as that of Nīlakaṇṭha (fourteenth century), even though these commentaries were not yet widely available as edited texts. Most frequently, however, they cite BAB for its mathematical contents, with little attention paid to its relationship with Ab.[79] At times, Datta & Singh mingle the substance of BAB with the contents of Bhāskara's other astronomical texts.[80]

With political independence and the creation of institutions for the study of the history of science in India, a new wave of editions appeared. K. S. Shukla took center stage in this movement. In 1959, he published an edition of PG

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73 (Clark 1930).

74 (Datta 1935).

75 Despite this tendency, they also embraced the dying tradition of mastering Sanskrit texts on *jyotiṣa*. At the end of his life, B. Datta was addressed as *pandit*. The enduring quality of their translations reflect their mastery of the Indian intellectual tradition. Indeed, "Hindu Mathematics" effectively blends two traditions, the lore of *jyotiṣa* and the modern history of mathematics. A detailed scrutiny of Datta & Singh's works could probably yield much useful information about the tradition of *jyotiṣa*.

76 (Datta 1935, Volume I, 125).

77 (Datta 1935, Volume I, 66–67; 196; 211. Volume II, 93–95).

78 (Datta 1935, Volume I, 170). See also, SYAB as in *op. cit.*[Volume II, 91, footnote 4].

79 (Datta 1935, Volume I, 80, 82, 87, 130, 204, 239; Volume II, 87, 238).

80 Thus, the whole portion of Volume 2 devoted to the *kuṭṭaka* quotes all the different texts which appear in Bhāskara I, even though these passages sometimes present Bhāskara's own algorithms, and at other times only explain algorithms in Ab.

together with APG and an English translation of PG at the University of Lucknow.[81] He then turned to Bhāskara's work, first editing and translating his treatises, which can be interpreted as elaborations of Āryabhaṭa's astronomy, the *Laghubhāskarīya* and the *Mahābhāskarīya*.[82] In 1976, K. S. Shukla and K. V. Sharma jointly published an edition and translation of the AB and editions of BAB and SYAB under the aegis of the Indian National Science Academy.[83]

By the 1980s, a new generation had taken up the study of commentaries on mathematical subjects. On the one hand, publications on the Mādhava school of mathematics called the attention of historians of mathematics to the scholiasts of Āryabhaṭa; on the other hand, the Japanese students of D. Pingree, particularly T. Hayashi, published articles on the mathematical contents in different commentaries on Ab, BG and L. To this can be added the publications of F. Patte's Ph.D. and my own, which exemplify the growing interest in mathematical commentaries in Sanskrit at the end of the twentieth century.[84]

In his editions, Shukla uses commentaries in three separate ways: First, following Colebrooke's model, commentaries provide a philological assessment of the original text to be edited. Secondly, the commentaries are also used to explain the text. Thus, although Shukla did not translate APG, he refers to it in the written comments that accompany his translation of PG. At times, Shukla seems to believe that the commentators give a peculiar interpretation of the treatise but at other times he seems to suppose that the commentators serve to explain the contents. In his joint edition and translation of the Ab, commentators are consulted to add mathematical depth to the algorithms. At times, Shukla combed the commentaries in order to quote their conflicting interpretations. Finally, in some instances, especially in the case of BAB, Shukla esteems the commentaries as mathematical texts in their own right.[85] The tendency to accept commentaries not only as philological aids but also as independent mathematical texts has been growing. This inclination no doubt coordinates with a general trend within the history of mathematics at large, because such approaches seem characteristic of modern approaches to the Chinese corpus as well.

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[81] (Shukla 1959).

[82] (Shukla 1963), (K. S. Shukla, 1960)

[83] (Shukla and Sharma 1976), (Shukla 1976), (Sarma 1976).

[84] How closely can these attitudes toward commentaries be linked to developments in the field of Indology generally? Indeed, Indology has developed a special emphasis on the study of treatises and the contents of important commentaries but has somewhat neglected any reflection on the commentary as a specific kind of text. In the last five-to-ten years, however, a renewed interest in this kind of text has surfaced, as illustrated by the recent conference titled "Forms and Uses of the Commentary in the Indian world", held at Pondicherry in February 2005. See http://www.ifpindia.org/Forms-and-Uses-of-the-Commentary-in-the-Indian-World.html., or the previously cited publication (Tubb 2007).

[85] Before publishing his edition of BAB, Shukla published a number of analyses, which pinpointed the mathematical relevance of the text. (Shukla 1972)

In summary, commentaries have been used, read and analyzed but were seldom translated by modern historians of mathematics. This decision made sense when commentaries where thought of as philological tools, useful in the editing and understanding of the texts they treated, as was often the case. However, the lack of translations becomes surprising when commentaries are considered as independent texts on mathematics in their own right. Furthermore, if commentaries and treatises are seen as ballroom dancing couples, sometimes the focus had been essentially on the treatise without its partner, sometimes on the commentary without its partner, and sometimes on details of how their steps follow each other. However, the global picture of how they danse together has not been drawn, or even aimed at.

Relating Commentaries to Their Treatises: The Example of Square Root Extractions

In studies on the history of mathematics in India, the relationship of the commentaries to the text they explicated has generally been left unresolved. Reflections on the relation of one text to another one have usually been restricted to a simplistic "right or wrong" interpretation of the treatise by the commentary. Scholarship on the mathematical contents of commentaries has focused on the mathematical ideas they contained, essentially their proofs.[86] The role of the commentary, then, is implicitly limited to providing mathematical justifications of the treatise. Through the following examples of square root extractions, the relationship between the commentary and the treatise may be shown to be more complex

In the following, rules to extract square roots, which are found in Ab and PG will be examined. BSS provides only a rule to extract cube roots, and will thus remain outside the scope of the present study.

Extracting Square Roots Along Different Lines

The procedures for extracting square roots considered here rely on the decimal place-value notation. Moreover, unlike the interpolations commonly described in astronomical parts of treatises, these algorithms are not treated as "useful" procedures to extract square roots. Rather, all presume that the root is to be extracted from a perfect square.

The basic idea underlying the procedure is to recognize the hidden development of a square expansion in a number written in the decimal place-value notation. In other words, the procedure relies on recognizing a square of the

[86] Srinivas (1990), Patte (2004), and Plofker (2009). Strangely enough, few reflections on comments connected to the definition of the field of *gaṇita* have been published. Such reflections might help explain why chapters on *gaṇita* contain algorithms with little astronomical application, although they are included in treatises on astronomy. See Pingree (1981), Keller (2007), and Plofker (2009).

kind $(b_n \times 10^n + \ldots + b_i \times 10^i + \ldots + c)^2$ in a number written as $a_{2n} \times 10^{2n} + a_{2n-1} \times 10^{2n-1} + \ldots + a_1 \times 10^2 + a_0 \times 10 + c^2$. Crucial to this algorithm, then, is the ability to distinguish between powers of ten that are squares (the even powers), and those that are not (the odd powers).[87]

Let us note that the algorithm in Ab returns the square root directly, while the algorithm in PG first extracts the double of square root and then says that the result should be halved. Thus, although they are founded on the same idea, the two procedures differ in their intermediary steps. Here is not the place to expose their respective algorithms, but rather to concentrate on what treatises reveal that commentaries omit, and vice-versa.

This is the rule for the extraction of square roots as given by Ab[88]:

Ab.2.4. One should divide, constantly, the non-square ⟨place⟩ by twice the square root| When the square has been subtracted from the square ⟨place⟩, the quotient is the root in a different place||

Without any commentary, the algorithm is hard to understand. Part of the difficulty springs from the fact that the verse begins in the algorithm's middle and thus emphasizes its iterative aspect. Another part of the difficulty arises from Āryabhaṭa's pun: the same name (*varga*) is given to squared digits and also to the specific positions where digits are found, "square positions". This pun highlights the mathematical idea behind the root extraction. The "square places" of the decimal place value notation hint at the squaring of digits which produce the number at hand.

The two commentaries BAB and SYAB introduce a grid to smooth the difficulty caused by the pun. Instead of considering square and non-square places, even and odd places are used. In both cases, this clarification is achieved quite simply by the commentary: one word is merely substituted for another. Thus, BAB states[89]:

In this computation (*gaṇita*), the square (*varga*) is the odd (*viṣama*) place.

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87 For a general explanation of the different methods, see Datta (1935, Volume I, 170–171) and Bag (1979, 78–79).

88

bhāgaṃ hared avargān nityaṃ dviguṇena vargamūlena|
vargād varge śuddhe labdhaṃ sthānāntare mūlam||

For an explanation of the algorithm, see Shukla (1976, 36–37).

89 Shukla (1976, 36, line 15)

atra gaṇite viṣamam sthānam vargaḥ

Likewise, SYAB states[90]:

> In places where numbers are set-down (*vinyāsa*), the odd places have the technical name (*samjñā*) "square".

We will return to the different grids for positions in the decimal place value notation below. For now, let us consider the act of substituting a noun given in the treatise by another noun. These substitutions are common in the commentaries. In this case, the substitution serves two functions: first, it explains the literal meaning of the verse; second, it points out the mathematical meaning of the pun. Furthermore, this substitution of words indicates the standard by which the commentators believed the *sūtra* had been composed: a mathematical pun had been used to pin down the mathematical idea behind the algorithm. Ab gives the core mathematical idea of the algorithm; BAB and SYAB highlight it.

Ab's confusing pun was not taken up by PG[91]

> **PG.24. Having removed the square from the odd term, one should divide the remainder by twice the root that has trickled down to a place**
> **⟨And⟩ insert the quotient on a line||**
> **PG.25. Having subtracted the square of that, having moved the previous result that has been doubled, then, one should divide the remainder. ⟨Finally⟩ one should halve what has been doubled.||**

In PG, the formulation of the algorithm avoids all puns. In comparison to the formulation in Ab, the algorithm here is neither dense nor confused. The formulation does, however, give precise elements which lead to the concrete execution of the algorithm on a working surface. A line (*paṇkti*) is evoked. The metaphor of the movement of trickling down as a drop of water (*cyuta*) is used to describe the digit-by-digit appearance of the partial double root.

These precise descriptions are further developed in APG, which multiplies graphical depictions of partial roots, evokes operations as carried above (*uparita*) and below (*adhas*) and even states that the extracted partial double root slides like a snake (*sarpaṇa*, *sarpita*) to the next position.[92] In a solved example, the practical details of how the procedure it is to be carried out on a working surface are described. The intricacies of the positional system are precisely

[90] Sarma (1976, 36, line 15).

saṃkhyā vinyāsasthāneṣu viṣamasthānāni vargasaṃjñāni

[91] See Shukla (1959, 18 for the Sanskrit, 9–10 of the part in English for an explanation of the procedure as described in APG)

viamāt padas tyaktyvā vargaṃsthānacyutena mūlena|
dviguṇena bhajec cheṣaṃ labdhaṃviniveśayet paṇktau ||
tadvargaṃsaṃśodhya dviguṇaṃ kurvīt purvaval labdham|
*utsārya tato vibhajec śeṣa*ṃ *dviguṇīkṛtaṃ dalayet* ||:

[92] Shukla (1959, 18–19 of the Sanskrit, 9–10 of the English version. Taken together, they reveal Shukla's interpretation of how numbers are initially disposed and how they change during the execution of an algorithm, according to APG).

indicated by APG. However, no reference is made to the idea of partial squares found in Ab's treatise.

We see then the commentaries help us unveil how they perceived the different nature of Ab and PG as treatises. The emphasis is, on one side, on the idea behind the procedure (in Ab), on the other, on expressing all the different steps of the algorithm, including the fact that the double square is obtained on a separate line (for PG). And indeed, two different kind of treatises are involved here. Ab is a theoretical astronomical treatise while PG is explicitly devoted to practical mathematics (*loka gaṇita*). Clearly commentaries differ according to the type of texts they explicate. Although all commentaries include illustrated examples, APG is the only one to detail precisely how the intermediary operations are carried out, even countenancing the possibility that a doubled number might become bigger than 10 during the steps of the algorithm.[93] On the other hand, neither BAB nor SYAB insist on these intermediary steps, but, on the contrary, highlight only the essential idea behind the algorithm. PG concentrates on whole numbers, whereas SYAB and BAB emphasize the fact that the square root of fractions is the fraction of the square roots. The fact that commentaries correspond to the kind of text they explicate and give only what they deem appropriate in such circumstances is especially clear in the case of SYAB: SYAB draws on a knowledge of PG. In fact, SYAB actually quotes PG in this very verse commentary, not for the details of how the procedure is executed on whole numbers or the positioning of digits during the procedure, but for a rule concerning the square-root of fractions.

Thus, commentaries are not systematic, practical explanations of the general cases formulated in the treatises. Instead, commentaries follow closely what they deem is the aim of the treatise, explaining the text, linking it to other considerations, but not going into details which would not be appropriate for the kind of treatise at hand. A commentary of a theoretical treatise will not detail the execution of a procedure. Conversely the commentary of a practical text will not reflect on abstract ideas, even if authors of commentaries know better. Furthermore, eventhought the non textual practice of tabular computations seems to be the realm of commentaries, PG shows that treatises can also testify of these practices, although probably not in detail. Consequently, the style of commentaries depends on styles of treatises, or, more precisely, on how the authors of the commentaries read the intentions behind the treatises. An analysis of how commentaries, by word substitutions, have read the treatises can furthermore give us insights onto practices and thoughts that have until now not been analyzed: the use of the decimal place value as a formal notation.

93 Shukla (1959, 18 line 15–16).

Positional Notation and Extracting Square Roots

Although historians of mathematics in the Indian subcontinent have long insisted on showing that the decimal place value notation came from India, they have reflected comparatively little on how this concept varied among different authors, particularly how they conceived of (and used) the idea of position. Indeed, for BAB, SYAB and APG, decimal place value is a conventional notation by which the positions containing the digits used to make a number are an ordered set on a horizontal line.[94] This is how a "place" becomes a "position", although no new Sanskrit word is introduced to express this conceptual change. Is this positional notation thought of as a positional *system*? A close look at the way commentators treated the extraction of square roots enables us to understand better their conception of position.

Let us recall the rule Ab gives to extract square roots[95]:

> **Ab.2.4. One should divide, constantly, the non-square ⟨place⟩ by twice the square root| When the square has been subtracted from the square ⟨place⟩, the quotient is the root in a different place||**

Previously, we noted that one of the difficult aspects of this verse originates in a pun which conflates the square digits (*varga*) and the digits noted in "square positions". Ab considers the decimal place-value notation an ordered line of places for incrementally increasing powers of ten. To this reading, he adds a new grid to qualify the positions and distinguishes square powers of ten from the powers of ten that are not squares. Ab's interpretation of positions simultaneously addresses the mathematical dimension of decimal place value notation and the mathematical idea on which the algorithm rests. The commentary BAB, as well as SYAB, both help us understand Ab's verse by giving new names to these positions. Both commentaries start with the decimal place value notation, but consider decimal place value notation more broadly. They count the positions in which the digits are noted, starting on the right, from the lowest power of ten, and continue toward the left. All the even numbers of this enumeration indicate "even places", and odd numbers denote "odd places".

Given that 10^0 starts this enumeration, a table may illustrate the correspondence of what Ab calls "square places" with the "uneven places" of BAB and SYAB and the equivalence of what Ab calls "non-square places" with the "even places" of BAB and SYAB:

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[94] (Keller 2006b).

[95] *bhāgaṃ hared avargān nityaṃ dviguṇena vargamūlena|*
vargād varge śuddhe labdhaṃ sthānāntare mūlam||

For an explanation of the algorithm, see (K. S. Shukla: 1976, 36–37).:

10^5	10^4	10^3	10^2	10^1	10^0
non-square place (*avarga*)	square place (*varga*)	non-square place	square place	non-square place	square place
even place (*sama*)	odd place (*viṣama*)	even place	odd place	even place	odd place
6	5	4	3	2	1

Commentators then add their own grid to the ordered list of places that define the decimal place value notation. This grid considers the notation outside of its mathematical content, as a tabular form with a numbered list of items on a line. The commentators assess this tabular form mathematically through odd and even numbers.[96] This mathematical assessment is not directly related to the algorithm, but the commentators link their grid to the one used by Ab through a simple substitution of one word for another. These substitutions of names are summarized in Table 4.

Table 4 Names of places in the algorithm to extract square roots

Texts	Even powers of ten	Uneven powers of ten
Ab	*varga*	*avarga*
BAB	*viṣama*	*sama*
PG	*viṣama*	nihil
APG	*viṣama*	*sama*
SYAB	*viṣama*	*sama*

PG uses the same vocabulary as BAB[97]

PG.24. Having removed the square from the odd term, one should divide the remainder by twice the root that has trickled down to a place
⟨And⟩ insert the quotient on a line||
PG.25. Having subtracted the square of that, having moved the previous result that has been doubled, then, one should divide the remainder. ⟨Finally⟩ one should halve what has been doubled.||

[96] BAB introduces this assessment through a linguistic analysis of the term *avarga*, noting: (Shukla 1976, 52)

tasya eva nañā viṣamatve pratisiddhe avargaḥ iti samam sthānam yataḥ hi viṣamam samam ca sthānam

Since a non-square ⟨takes place⟩ when oddness is denied, by means of ⟨the affix⟩ *nañ* ⟨the expression refers to⟩ an even (*sama*) place, because, indeed, a place is either odd or even.

[97] See Shukla (1959, 18 for the Sanskrit, 9–10 of the part in English for an explanation of the procedure as described in APG:

viṣamāt padas tyaktyvā vargaṃ sthānacyutena mūlena|
dviguṇena bhajec cheṣaṃ labdhaṃ viniveśayet paṇktau ||
tadvargaṃ saṃśodhya dviguṇaṃ kurvīt purvaval labdham|
utsārya tato vibhajec śeṣaṃ dviguṇīkṛtaṃ dalayet ||:

In regard to questions of place, APG supplies the following comment to the verse[98]:

One should subtract a possible square,[99] from the *viṣama* place of the square quantity, ⟨in other words⟩ from what is called odd (*oja*), that is from the first, third, fifth, seventh etc., ⟨place⟩, from the places for one, one hundred, ten thousand, one million, etc. from the last among other places.

In the case of finding the square root of 188624, APG adds[100].

In due order starting from the first place which consists of four, producing the technical names (*samjñā karana*): "odd (*viṣama*), even (*sama*), odd (*viṣama*), even (*sama*)".

Setting down:

sa	vi	sa	vi	sa	vi
1	8	6	6	2	4

In this case, the odd terms which are the places one, a hundred, ten thousands, consist of four, six and eight. Their last odd term is the ten thousand place which consists of eight.

APG expounds precisely the mathematical background relative to the decimal place value notation just alluded to in the treatise. Indeed, the anonymous commentator uses different possible expressions to name a position: its value within a power of ten, the place it has in the row of numbers noted on the line, and the digit which is noted in this position. The values of power of tens that a position stands for are denoted with a *tatpuruṣa* compound ending in *sthāna*. Inside the compound, an enumerative *dvandva* gives the particular powers of ten in increasing order (*ekaśatāyutasthānāni*, "the places for one, a hundred, ten thousands"). The place within the row of numbers may be described in several ways. APG numbers the positions, starting with one for the lowest power of ten and increasing successively. These places are enumerated by a *dvandva* which gives the ordinal forms of the particular positions (*ekatṛtīyapañcamasaptamāder*, "for the first,[101] the third, the fifth, the seventh, etc."). In conformity with PG, APG then reproduces the *viṣama* / *sama* (odd /even) terminology found in BAB and SYAB. In contrast to BAB and SYAB, however, PG and APG insist that

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[98] Shukla (1959 18, line 10–12)

vargarāśer viṣamāt padād ojākhyād ekatṛtīyapañcamasaptamāder eka-śatāyutaprayutādisthānebhyo 'nyatamasthānād antyāt padāt sambhavinaṃṃtyajet:

[99] The adjective *saṃbhavin* conveys both the meaning "appropriate" and "conjectured", the subtext is thus understood an "appropriately conjectured" square.

[100] Shukla (1959, 18, line 19–22)

ānulomyena ekasthānāc catuṣkāt prabhṛti viṣamaṃ samaṃ viṣamaṃ samam iti saṃjñākaraṇam /

sa	sa	sa	vi	sa	vi
1	8	6	6	2	4

atra catuḥṣaḍaṣṭakāni ekaśatāyutasthānāni viṣamapadāni tebhyo 'yutasthānastham aṣṭakam antyaṃ viṣamapadaṃ:

[101] *eka* however is used here and not *prathāma*.

positions be used within an ordered set, or *series* of numbers, for which there is a first and a last term. PG describes the terms of a series as *pada*, a word which APG glosses with the expression *anyatamasthānāt antyāt*, "the last among all other places". Finally, the particular digits are understood as tools to be used within these positions. This understanding may explain why the names of numbers end with the suffix -*ka*, such as *catuḥṣaḍaṣṭakāni*, ("consists of four, six and eight").

Places are used and qualified in different classifications: some underline their values, others their positions in an ordered line, others again pinpoint their mathematical qualities (as squares). These multiple qualifications point to the fact that all considered authors, do indeed use the decimal place value as a *system of positions* which can be qualified in as many different ways an algorithms requires.

Previously, we have seen that glosses, the act of substitution common to all the commentaries, not only explain the literal meaning of the verse but also highlight the mathematical meaning of a pun. The substitution also creates a new grid, a new system of positions, and appends this grid to the grid from the treatise which the commentary has just elucidated.

A close connection between commentary and treatise may explain the various ways a place becomes a position on an elaborate grid, resting not only upon the decimal place value notation and the algorithm to be executed, but also depending on the formal system created by the notation itself. The line of place value can be ordered in many different ways.

Different lines on which the extraction of square roots may be executed are recalled, and different grids are correspondingly described by APG: the horizontal expansion of the decimal place value notation is extended into a table, with some operations conducted in columns and others on rows, as is the case for other elementary arithmetical operations. A chronological perspective might elucidate the historical evolution: over time, the decimal place value notation seems to have slowly taken on a formal aspect, namely, over time the decimal place value notation, slowly developed into a tabular form which could be used not referring systematically to what positions meant in terms of values of powers of ten.

Conclusion

Investigations into how commentators read mathematical treatises can lead to conceptual insights into the practice of the decimal place value notation. A simple word substitution, such as that used in BAB, SYAB and APG, shows how the decimal place value notation may be considered a horizontal line of a table in which formal operations can be carried out.

Two different kinds of *śāstra*s have been studied here: one emphasized mathematical ideas, the other focused on mathematical practices. The first belongs to a chapter of an astronomical treatise; the second belongs to a practical mathematical text. Each has different ways of describing algorithms. The study of these different descriptive practices enables a deeper understanding of the use of these texts and what they intended to convey.

The purpose of the treatises, as the commentators understood them, directed the aims and composition of the commentaries. The commentators' interpretation of the treatises determines whether their commentaries concentrate on abstract mathematical ideas or emphasize how an algorithm is executed out on a working surface. Treatises then can hint to "pratical knowledge", that commentaries can choose to spell out or not. However in all cases, the commentarial work consists in establishing relations, integrating what is hinted in the verse into a network of other systems.

If the ballroom dancing metaphor is taken up again, the treatise seems to lead the danse, but this is what the commentator wants us to believe. Like a virtuose yet discrete partner, the commentator relies on his techniques and knowledge to showcase the treatise. Such an attitude, which has its counter examples, helps us understand why a stylistic criteria to distinguish commentaries from treatises is so difficult to find.

A late tradition may have considered commentaries as mere fragmentary explanations and not full texts. The examples studied here show that this might have been the case for a late seventeenth century tradition in South India. Looking at texts themselves, one can wonder wether they were made to be read, verse by verse, verse-commentary by verse-commentary in due order or if they were conceived to be read in any order, separately, while looking for a specific explanation. In the case of the three commentaries on square root extraction, the decimal place value notation and the rules for elementary operations are used. With this limited prerequisite knowledge, the commentary may be read as an autonomous text. Such an autonomous verse commentary reading may not hold for all algorithms and would further discard the more integrated vision of what the treatise was about that a full commentary could provide. It remains to be determined wether authors who wrote commentaries thought of them as texts to be subjected to partial readings. Should an oral culture of texts be imagined, where commentaries and treatises are known entirely but can be quoted and mobilized in fragmentary ways?

Along the way, some information on who caused a text to be copied has been gathered. In the case of SYAB, scholarly astronomers, ritualist families and religious institutions of South India had the texts copied. This information may prove useful in confirming or denying our hypothetical constructions. Coming back to how commentaries were read, a hypothetical evolution can be suggested: An early modern pandit tradition may have informed the way Colebrooke and other European scholars treated Sanskrit commentaries. Such attitudes could have mingled with European traditions which esteemed mathematical texts not for their textual characteristics but rather for their mathematical content. This attitude has resulted in the kind of historiography prevalent today when studying mathematical commentaries.

Acknowledgment: I would like to thank K. Chemla, F. Bretelle, C. Proust and M. Ross for their comments, suggestions, improvements and encouragement offered on several drafts of this article.

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Mesopotamian Metrological Lists And Tables: Forgotten Sources

Christine Proust

From the outset of Mesopotamian archaeology, the archaeologists have constantly been excavating school tablets from the major sites of the Near East; these tablets were found incorporated in walls, in filling material, in pavements or abandoned in buildings which housed a scribal school. The majority of the tablets date from the Old Babylonian period, i.e. the beginning of the second millennium B.C. Today these tablets are spread all over the world, kept in the reserve collections of several important archaeology museums of the Near-East, of Europe, and of the United States. Ten to twenty percent of these tablets are mathematical tablets. Some of the school mathematical texts have drawn the attention of the historians of science, in particular the numerical tables (multiplication tables, tables of reciprocals, tables of squares, etc.); but others remained in the dark. The latter were the metrological tablets, i.e. tablets containing enumerations of measures of various types (capacities, weights, surfaces, lengths) either in the form of simple lists, or in the form of correspondence tables. Why have these metrological texts been studied so little? What do they tell us about our comprehension of cuneiform mathematics? These are the questions this article intends to answer.

First, I shall give a short description of the Old-Babylonian metrological lists and tables. In the second section, I shall present the way the metrological lists and tables have been used by historians, from the publication of the earliest examples at the end of the nineteenth century, to the present "archival studies". In the third section, I shall concentrate on the sources from Nippur and shall study in detail the various processes of selection that have shaped the lots of school tablets discovered by the archaeologists, the tablet collections set up in museums, and finally the corpora assembled by the historians. The aim of this analysis is an attempt to reconstruct a set of tablets which constitutes the best representation of the mathematical activities of the Old Babylonian schools in

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F. Bretelle-Establet (ed.), *Looking at It from Asia: The Processes that Shaped the Sources of History of Science*, Boston Studies in the Philosophy of Science 265,
DOI 10.1007/978-90-481-3676-6_8,

Nippur. The last section will show the purpose of replacing the metrological lists and tables in their original "archives" i.e. the lots of school tablets.

Description of the Sources

Before pursuing this investigation, a precise description of the metrological lists and tables in the Old Babylonian period should be given. These texts, which were used as school exercises, are attested not only throughout Mesopotamia, but also in Elam (Susa), and in Anatolia in slightly different forms.[1] The same sequence is often reproduced on numerous tablets. In Mesopotamia, these duplicates contain minor variants, but they are sufficiently uniform to allow a general description of the unique text they contain. This text, completed by possible variants, constitutes a "composite text"; it assembles the list of items—from at least one source—arranged the most accurately possible according to the epigraphic data.[2] The composite text relative to the metrological lists contains, in increasing order, an enumeration of measures of capacities, of weights, of surfaces, or of lengths. Concerning the metrological tables, the composite text contains the same items as the corresponding lists, but adds a sexagesimal number written in place value notation to the right of each measure. As regards the material evidence, large tablets have been recovered from Nippur and other sites, which give either the integrality of the metrological lists or the integrality of the metrological tables. These recapitulative texts always display the components in the same order: capacities, weights, surfaces, lengths. However, in most cases, our sources are pupils' rough work containing brief excerpts of the lists or tables. This is the case in the following two tablets, of which a reproduction is given below (Figs. 1 and 2). The first is fragmentary, it contains an excerpt of a metrological **list** of length

obverse
[4] danna
[4 1/2 danna]
[5] danna
5 1/2 [danna]
6 danna
6 1/2 danna
7 danna

reverse lexical (list of signs)

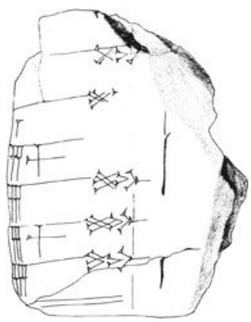


Fig. 1 Metrological list of lengths (Ist Ni 3352, Istanbul); copy: (Proust 2007b, p. XI)

[1] (Michel 2008).

[2] I shall come back to the question of the item order below. I have reconstructed a composite text from the mathematical school tablets from Nippur, which are of a remarkable stability (Proust 2007b, 311–324).

obverse	
1 šu-si	10
2 šu-si	20
3 šu-si	30
4 šu-si	40
5 šu-si	50
6 šu-si	1
7 šu-si	1.10
8 šu-si	1.20
9 šu-si	1.30
1/3 kuš$_3$	1.40
½ kuš$_3$	2.30
2/3 kuš$_3$	3.20
5/6 kuš$_3$	4.10
1 kuš$_3$	5
reverse	
1 1/3 kuš$_3$	6.40
1 ½ kuš$_3$	7.30
1 2/3 kuš$_3$	8.20
2 kuš$_3$	10

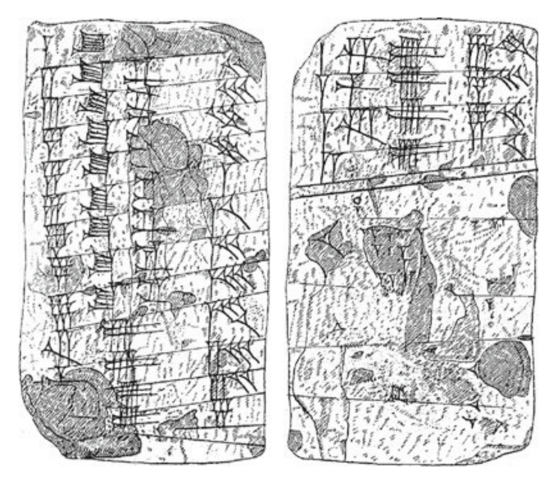


Fig. 2 Metrological table of lengths (HS 241, 7 × 5,1 × 2,4 cm, Jena); copy: (Hilprecht 1906, n° 42, p. 27)

measures, the second is an excerpt of a metrological **table** of length measures (see also metrological list of capacity measures in Fig. 3).

In order to express a measure (for example 6 1/2 danna), the scribes wrote count graphemes (here 6 1/2) followed by a unit grapheme (here danna; 1 danna ≈ 10 km).[3] The difficulty for the scribes must have resided in the fact that the numerical systems varied according to the chosen units of measure. Furthermore, the factors between units are variable (except for weights where the factor 60 dominates). The metrological lists must have served as an aid to help make sense of all these systems. They describe extensively not only the different units and factors between them, but also the numerations that are associated with them. A modern synthetic presentation of the metrological systems is given below in the form of factor diagrams: the names of the units of measure are given along with the multiplying factors defining each unit with respect to its multiples and submultiples (see Table 1 below).[4]

The metrological tables are of a different nature. Although they are composed of the same entries, they do not have the linear structure of the lists, since they introduce a second dimension by giving for each measure its equivalent as a sexagesimal number in place value notation. I have placed these equivalents

[3] All the mathematical tablets from Nippur kept in Istanbul (Ist Ni) and Jena (HS) have been integrated into CDLI database (http://cdli.ucla.edu/).

[4] This clear representation was proposed by J. Friberg (1993, 387). A complete description of the numeration systems associated with each unit of measure can be found in many publications, for example (Powell 1987–1990; Friberg 1993; Nissen, Damerow, and Englund 1993; Proust 2007b; 2009).

Table 1 Metrological systems

Capacities (1 sila$_3$ ≈ 1 litre)								
gur	←5~	bariga	← 6~	ban$_2$	←10~	sila$_3$	←60~	gin$_2$
5		1		10		1		1
Weights (1 gu$_2$ ≈ 30 kg)								
gu$_2$	←60~	ma-na	← 60~	gin$_2$	←180~	še		
1		1		1		20		
Surfaces (1 sar ≈ 36 m²)								
GAN$_2$	← 100~	sar	← 60~	gin$_2$	←180~	še		
1.40		1		1		20		
Lengths (1 ninda ≈ 6 m)								
danna	←30~	UŠ	← 60~	ninda	← 12~	kuš$_3$	← 30~	šu-si
30		1		1		5		10
Heights								
danna	←30~	UŠ	← 60~	ninda	← 12~	kuš$_3$	← 30~	šu-si
6		12		12		1		2

under the corresponding units in the factor diagrams below. As regards lengths, there are in fact two tables of correspondences between measures and numbers in place value notation: the one for horizontal dimensions (lengths, widths, diagonals) and the other for vertical dimensions (heights, depths). This table of supplementary heights was used for the calculation of volumes (in the following, this point will be considered in connection with F. Thureau-Dangin's work).

Let us end this brief presentation of the metrological texts with some details regarding the notation of measures and the notation of the numbers they contain. The numerical values used to express measures belong to different systems, as indicated above. It is not the aim of the present article to describe all the peculiarities of these notations.[5] The essential point, which I would like to stress here, is the common characteristic of these systems: they all use an additive principle.[6] Otherwise, the numbers written opposite each measure in the metrological tables are sexagesimal and use a positional principle (or place value notation): the digits are written using the same signs whatever their position might be; each sign is defined by its position in the number; each position represents sixty times the one preceding it (i.e. the position on its right). The 59 digits of this numeration of base sixty are written using signs representing 1 (𒁹) or 10 (𒌋) that are repeated as many times as necessary. The example given below is a number with three sexagesimal places containing the successive "digits" 40, 26 and 44:



(44.26.40)

The cuneiform place value notation has yet another particularity, the importance of which will appear in the course of this article: there is no graphical

[5] See publications quoted in preceding note.

[6] See (Proust 2008a).

means giving the position of units proper. For example, the numbers, which we write 1, 60, 1/60, are all represented on the tablets by the same sign 𒁹. Thus the magnitude of the numbers in place value notation is not specified. This property contrasts the numbers in place value notation with the numerical values employed to write measures, since the latter are written using an additive principle, and therefore represent well defined quantities. F. Thureau-Dangin adopted the term "abstract number" to designate sexagesimal numbers in place value notation, the adjective "abstract" referring to the fact that their order of magnitude is unspecified; I have used this term for the same reason, but also to underscore another property which can be seen in the metrological tables, although a general property in the mathematical and school documentation: these numbers are never followed by a unit of measure.

Historiographical Survey

Archives, Lots, Corpora and Collections

The metrological lists and tables can be tackled in different ways that can be partly linked to different historiographical periods. The first approach is to consider only the text. This means led to many important results in the early stages of Assyriology. At that time, the discovery of a large corpus of texts implied an urgent need to characterize the main principles of Mesopotamian metrology; this knowledge was essential to understand the administrative and mathematical texts. The origin, the archaeological context and the material aspect of the tablets containing them, could be considered in these circumstances as relatively secondary. This standpoint was reinforced by the fact that during the Old Babylonian period, the metrological system was highly standardized over a large geographical area which enabled a reconstruction of the system using sources from different provenances. The second approach, which is described by some authors as an "archival"[7] approach, consists in considering the tablets as well as the texts. Thus the emphasis is placed on lots of epigraphic documents discovered in the same archaeological locus and therefore displaying a certain coherence. The most common term used to refer to a lot of school tablets found in a same *locus* by excavators is "school archives", though this is a language misuse in the sense that the ancient scribes had no

[7] See the work of the *30e Rencontre Assyriologique Internationale* published in 1986 (Veenhof 1986a). In his introduction, K.R. Veenhof draws a general picture of the changes in perspective that were introduced in Assyriology by the archival approach. He shows the relevance of paying great attention to the provenance of the tablets, to their material history and to the conditions of the creation of museum collections for the development of an economic, a social, and a political history of the ancient Near-East (Veenhof 1986b). However, the work of this *Rencontre* essentially concentrated on administrative archives and did not consider much the lots that came from libraries and schools.

intention of creating archives of school drafts.[8] Nevertheless such an approach requires precise knowledge of the circumstances of the discovery of the tablets by the archaeologists, but this clear archaeological context is often lacking. In this respect, let us recall the two principal means by which collections of cuneiform tablets have been set up, the one resulting from systematic excavations, the other resulting from clandestine excavations and from the market of antiquities.[9] The metrological lists and tables may have followed either one of these routes. But the tablets—often school tablets which had been reused as building material—are mostly of poor appearance and therefore have been of no interest to collectors. The majority of the tablets come from systematic excavations, they have been accumulated and often forgotten in museum reserves. The Assyriologists did not take an interest in these texts once the units of measures had been identified, nor did the historians of mathematics. The latter, with a few exceptions, did not consider these tablets as mathematical texts proper.[10] And it is only recently that these texts have become a subject of interest.

The different approaches rapidly mentioned above have a heavy impact on the studies of cuneiform mathematical texts. Historians choose certain criteria when they select their corpora of texts. These criteria can be archaeological (tablet lots of same provenance and dating), thematic (corpora of texts dealing with an identical subject) or based on museological considerations (museum or private collections); let us note that these criteria are not exclusive.[11] For

[8] The school tablets were not meant to be archived, on the contrary they were meant to be thrown away after having been used (see section 3). P. Clancier's article, in this volume, gives more information concerning the cuneiform documentation that can appropriately be named "archives". See also (Veenhof 1986a).

[9] On this subject see the beginning of P. Clancier's article in this volume. The way that the market of antiquities shaped the collections, on which the Assyriologists base their work, has not been studied much; the antiques business has always been opaque and, in recent periods it has been more the concern of investigative journalism than the one of academic research (Brodie 2006, 12). On the damage caused to the archaeological heritage by the trafficking of antiquities and the question of the relations between researchers and collectors, see (Brodie 2006; Brodie, Kersel, Luke, and Tubb 2006). More precisely concerning the impact of illegal excavations on the study of cuneiform archives, see for example (Veenhof 1986b, 35).

[10] "*C'est un type de tablettes assez fréquent dans les musées, mais qui n'a pas attiré suffisamment l'attention. Les historiens des mathématiques les trouvant apparemment trop simples, une étude d'ensemble manque encore*" (Civil 1985, 77). Other authors have made similar remarks, for example (Michel 1998, 253; Robson 2004, 12). It must however be stressed that in some investigations, in particular in J. Friberg's publications, the metrological tables are studied as mathematical texts (see section 2).

[11] Considering the first category (studies of corpora that were made on archaeological criteria), let us mention the work of (H. Hilprecht 1906), and more recent examples like the studies of the mathematical tablets from Tell Harmal (Baqir 1950a, 1950b, 1951), from Susa (Bruins, and Rutten 1961), from Ur (Friberg 2000), from Nippur (Robson 2001; Proust 2007b). Considering the second category (studies of corpora made on museological criteria), let us mention *Mathematische Keilschrifttexte* (Neugebauer 1935), the chapters of which correspond to the various European and American museum collections; among the publications of mathematical texts based on public or private collections, generally of unknown

reasons of accuracy, in the following investigation I shall distinguish the groups of texts or tablets according to their mode of selection. I shall use the term "lot" along with P. Clancier to designate the tablets that were stored together for various reasons in the same archaeological deposit; in the case of the school texts, I shall also use the standard and evocative expression "school archives", even though it is inappropriate (this fact is evoked by the quotation marks). I shall save the word "collection" to designate the groups of tablets assembled by curators or collectors in view of their keeping in museums or private collections. "Corpus" will refer to the gathering of texts made by modern historians in order to study a particular topic; besides, these groupings are often taken from "lots" or from "collections".

It is of interest to compare the historians of mathematics' approach to the study of metrological texts with the one chosen by Assyriologists with respect to lexical lists. The lexical lists were first used to establish the Sumerian vocabulary.[12] Subsequently, the attention focused on the tablets themselves, and on the fact that they were school tablets.[13] In a similar way, the metrological lists and tables were first used to establish the Mesopotamian metrology. It is only recently that they have been considered as evidence of the mathematical activities in the scribal schools.

Periodisation

The historians' change of approach to the metrological lists and tables is manifest if one considers the various metrological lists and tables, which have

provenance, let us cite : (Robson 2000, 2004, 2005, Friberg 2005, 2007). The archaeological criteria may coincide with the museological criteria: the tablets from Susa published in (Bruins, and Rutten 1961) are all kept in the Louvre Museum, the ones from Nippur published in (Proust 2008b) are all kept in Jena. Considering the third category (studies of corpora made on thematic criteria), let us mention *Mathematical Cuneiform Texts* (Neugebauer, and Sachs 1945), the chapters of which are organized according to a thematic classification and no longer a museological one as it was the case in *Mathematische Keilschrifttexte*. The texts which have been studied by J. Høyrup (2002) are also grouped according to thematic criteria, different sections of the same tablet can be found in different chapters (for example, this is the case with the tablet BM 13901, the sections of which are analysed in four different parts of the book).

[12] This is the purpose of the large series called "MSL" (*Materialen zum sumerischen Lexikon*, and then *Materials for the Sumerian Lexicon*), which provides Sumerologists with the major part of their lexicographical material. MSL is the systematic publication of the Mesopotamian lexical lists. It is composed of 18 volumes; the publication of volumes 1–14, 16–17 and SS1 spreads over years 1937 to 1986: volume 15 was published in 2004.

[13] This change of approach, which is characterized by the attention paid not only to the texts but also to the tablets, has been nicely shown by N. Veldhuis in his study of the lexical lists from Nippur (Veldhuis 1997, 3).

been published[14] since the beginning of Assyriology. This chronology reveals three major periods:

- At the outset of Assyriology, the metrological lists and tables were the subject matter of important publishing work; in particular let us mention the contributions made by H. Hilprecht and F. Thureau-Dangin. The lists and tables allowed the comprehension of the major characteristics of Mesopotamian metrology: the notation of the units of measure, their relative values, and the notation of the associated numerical values.
- During the 1930–1975 period[15]—i.e. the period during which the most important part of the corpus of cuneiform mathematical texts known to us today was deciphered, translated and interpreted—the metrological lists and tables hold a marginal position among the published texts. An analogous observation could be made with respect to the proportion of articles containing commentaries on the metrological lists and tables.
- During the recent period, the publication of school texts, which includes the metrological lists and tables, has enjoyed renewed favor in a spectacular way.

In this section, I shall particularly insist on the first period, which isn't usually considered in the historiography of cuneiform mathematics. Concerning the 1930–1975 period, I shall limit myself to pointing out some important studies for the present investigation, although probably of minor importance as regards the extent of the publishing work of the time; on this subject let us refer to the work of J. Høyrup and J. Friberg.[16] The last period is discussed at length in sections 3 and 4 of this article.

Characterization of Mesopotamian Metrology

The first metrological tablet coming from the excavations in Iraq was published in 1861; it is a large table from Larsa (modern Senkereh) that is kept in the

[14] The publication of the cuneiform texts does not obey stable or fixed rules from one period to another, nor from one author to the other. Here, the term "publication" of a tablet refers to a publication that gives a minimum of information on the tablet (inventory number, provenance and dating, when this information is known) and at least a copy or a transcription—even partial—of the tablet.

[15] This corresponds to the periods that Jens Høyrup calls the "heroic era" (1930–1940) and the "triumph of translation" (1940–1975) (Høyrup 1996)

[16] (Friberg 1982; Høyrup 1996). J. Høyrup's historiography, which is today accepted as the authority on this matter (1996), focuses on the work relative to the great erudite mathematical texts of the Old Babylonian and Neo-Babylonian periods, and thus begins in 1930. J. Friberg's notes do not contain a historiographic study proper, but rather give a chronological presentation of all cuneiform mathematical publications since 1854 *i. e.* the beginning of Assyriology – until 1980; this annotated bibliography is a basic working tool for the specialists, but unfortunately it has never been published.

British Museum (Museum number BM 92698[17]). It was at once considered of major importance by F. Thureau-Dangin[18]. Thanks to this tablet, G. Smith partially identified the metrological system of lengths in 1872[19]. But neither the school character, nor the mathematical character of the text had been recognized at this date. Therefore the first cuneiform mathematical texts historians came across were the metrological tables, and in some ways without them knowing it. Following the discoveries made by the Babylonian Expedition, H. Hilprecht—the scientific director of the excavations—revealed the existence of scribal schools and cuneiform mathematics to the scientific world and to the general public, on the one hand thanks to the monumental account of his expeditions in 1903 and, on the other hand, by the publication of the mathematical tablets found in the "Temple Library" of Nippur in 1906.[20] It is interesting to point out that H. Hilprecht who discovered at the same time the schools and the mathematics, did not dissociate the metrological texts from the mathematical texts. A division line only appears later, when attention focuses on erudite mathematics. With few exceptions[21], the work of H. Hilprecht published in 1906 remains without any equivalent until the recent publication of the school tablets from Ur, from Nippur and from Sippar etc. (see the end of this section). As noted by E. Robson, Hilprecht's observations on the school tablets are remarkable, in particular those made with reference to the material aspect of the tablets.[22] Furthermore, the lines of Hilprecht's copies are extremely precise and depict not only the cuneiform signs but also the asperities of the clay surface; these copies reveal both his interest in the texts and in the tablets (see Fig. 2 above and Fig. 3 below).

His description of "type II" tablets, made in terms hardly to be amended today, is given below; note that the above terminology (i.e. type II) was only adopted recently by the Assyriologists, who defined a typology of the texts produced in a school context, more than 70 years after Hilprecht's description:

> On the Obverse of Nos. 20, 24, 37 (cf. Pls. IV and XIII) the priest in charge of the class wrote the left column with his own hand as a model for the pupil, who copied the text in the right column. When the exercise was satisfactory, the teacher removed the pupil's writing by scraping the upper layer of clay off the right column. Frequently, however,

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[17] This tablet named "Table of Senkereh" by the Assyriologists of the time, has been published in several stages by (Rawlinson, and Smith 1861; Lenormant 1873; Lepsius 1877; Thureau-Dangin 1930a; Neugebauer 1935–1937).

[18] For him it is "depuis le début de l'assyriologie la *crux interpretatum*" (Thureau-Dangin 1909).

[19] (Smith 1872 ; Friberg 1982).

[20] (Hilprecht 1903, 1906). In fact Hilprecht's discovery was violently contested by some members of the expedition (see below).

[21] A notable exception is E. Chiera's study of lexical lists of names published in 1916. This study contains one of the first systematic descriptions of types of school tablets (Chiera 1916; Veldhuis 1997, 5).

[22] (Robson 2002, 238–239).

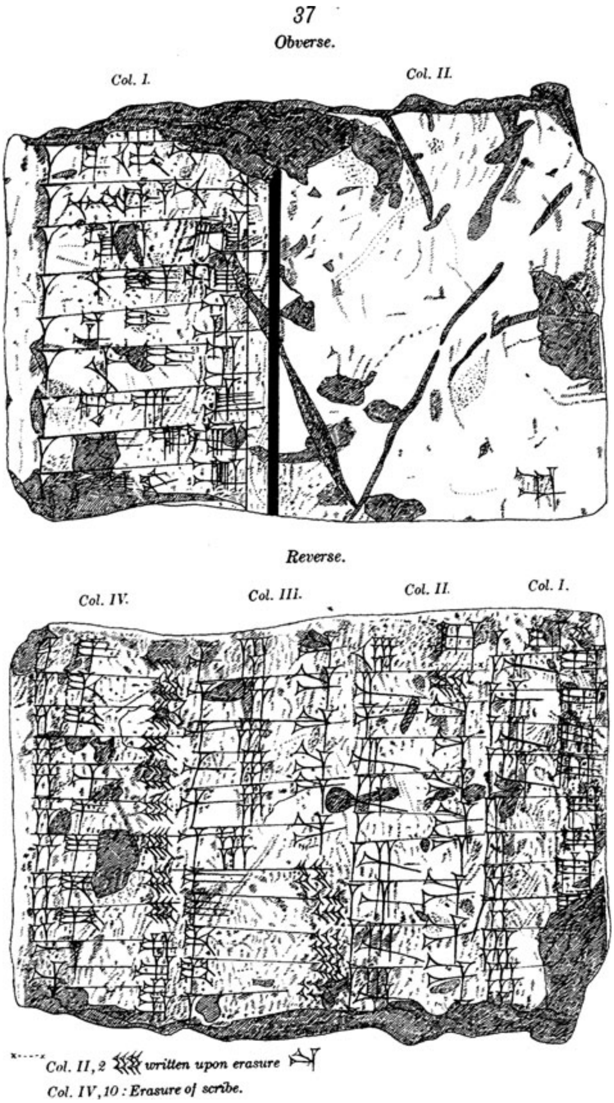


Fig. 3 Type II tablet from Nippur—Copy by H. Hilprecht[23]

[23] Tablet kept in Jena (HS 239), published by H. Hilprecht (1906, n°37); two other fragments of the same tablet (HS 250 + HS 256) were found in Jena's collection by J. Oelsner (Proust 2008b, n°4). The complete tablet should have measured approximately 18 cm high and 8.5 cm wide. On the obverse, one can see a master's model giving a list of signs (Proto-Ea), and remnant signs and traces of erasure can be distinguished on the surface meant to contain the copies; a metrological list of capacity measures is inscribed on the reverse

> before destroying the pupil's exercise, the teacher turned the tablet over and inscribed the Reverse with a similar or an entirely different text, sometimes writing his model twice or three times, after the manner of our *Schulvorschriften*. On some of the tablets examined the right column has been inscribed and scraped off so frequently that it is considerably thinner than the left column. They are even specimens where the right column has been cut off entirely. In other cases the pupil's exercise has been removed so superficially that, like a Greek palimpsest, the traces left aid in deciphering the contents of the preserved but frequently damaged left column (Hilprecht 1906, x–xi[24]).

The importance of all these details for the understanding of the school context will subsequently be largely underestimated, until a recent renewal in the studies of school texts occurred.

As for F. Thureau-Dangin, he took a particular interest in metrology, probably because of the great variety of genres of texts that he studied (literary, administrative, mathematical). His remarks on the subject pepper the "notes" of the *Revue d'Assyriologie* from 1893 to 1940. When reading these notes one is struck by the diversity of exploited sources: tablets of different origin, often unknown, and dating of periods that extend from Sargon of Akkad (approx. 2300) to the Seleucid era (approx. 300), administrative texts, mathematics, monumental inscriptions, bricks, various artefacts, stories of Herodotus. The metrological tables only represent a small portion of these sources, but he considered them as crucial. F. Thureau-Dangin's deep understanding of numbers and of Babylonian calculation can possibly be explained by his familiarity with the administrative, literary and mathematical sources. The importance he attached to the tables enabled him to grasp essential aspects of the practice of numbers. I shall only mention two of these aspects here: his discovery of the definition of units of volume in the mathematical texts, and his analysis of the particularities of numbers in place value notation.

As early as 1900, F. Thureau-Dangin revealed the singular fact that the units of volume have the same name as the units of surface.[25] In 1930—and in a more developed manner in his *Textes Mathématiques Babyloniens*[26]—he detailed the scribes' construction of volume units: each unit of volume is equal to a unit of surface associated with a depth of 1 $kuš_3$ (50 cm) and bares the same name. The sources he used to establish this definition were the mathematical texts and the "Table of Senkereh" BM 92698.[27]

More importantly, F. Thureau-Dangin drew attention to the fact that there are two different correspondences with respect to the linear measures in the metrological tables. The existence of two metrological tables of length measures had been noted by H. Hilprecht, who had published examples of these two types

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[24] See a similar description of "type II" tablets, in section 3.

[25] (Thureau-Dangin 1900, 112)

[26] (Thureau-Dangin 1930b; Thureau-Dangin 1938, xvi–xvii).

[27] (Thureau-Dangin 1938, xiv, xvii). F. Thureau-Dangin (1930b) mentions that H. Waschow independently reached the same results; the latter's conclusions were published slightly later (Waschow 1932).

as early as 1906.[28] But it was F. Thureau-Dangin, who showed the importance of these two correlations for the understanding of volumes. And yet this major point was not really exploited in later works. It is not mentioned by O. Neugebauer, who doesn't recognize it in his publication of a tablet from Nippur (2 N-T 530).[29] The role, in volume calculations, of these two correspondence tables, the one used for horizontal dimensions and the other for vertical dimensions, was in some ways "rediscovered" and developed much later by J. Friberg.[30]

Another essential aspect of F. Thureau-Dangin's work concerns the sexagesimal numbers in place value notation that are used in the mathematical texts. He was especially interested in the lack of indication of magnitude order in the cuneiform writing; this particularity has already been mentioned above:

> Il est important de faire observer que, dans cette notation, il n'existait aucun moyen d'exprimer l'ordre absolu de grandeur d'une unité donnée. Hilprecht a soutenu que dans les tables de division qu'il a publiées, le nombre à diviser est 60^4 (c'est-à-dire 12 960 000, qui serait, selon lui, le "nombre de Platon"). En réalité, la question ne se pose même pas, car l'unité considérée peut être d'un ordre quelconque et représenter aussi bien l'unité simple que 60 ou une puissance de 60, ou encore une unité fractionnaire, 1/60, $1/60^2$ etc. (Thureau-Dangin 1921, p. 124)

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Even more significantly, F. Thureau-Dangin showed that there existed a link between this particular way of noting numbers and the manner of calculating; this connection, as we shall see below, is fundamental:

> Si la grandeur absolue pouvait sans inconvénient rester indéterminée, c'est parce que le système n'était destiné qu'à servir d'instrument de calcul. [. . .] Le système savant offrait le grand avantage d'éviter les rompus. Tout nombre, dans ce système, présente la forme d'un entier (Thureau-Dangin 1938, p. x).

Thus,

> L'expression du nombre atteint dans le système savant un degré de simplicité, d'homogénéité et d'abstraction qui n'a jamais été dépassé (Thureau-Dangin 1938, p. xix)

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The important point underlined by F. Thureau-Dangin is that the absence of information relative to the order of magnitude is not a deficiency of cuneiform writing. On the contrary it is a property linked to the use of numbers: the

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[28] Hilprecht noticed the two correspondences, but didn't try to explain them (Hilprecht 1906, 35, 66, pl. 27 n° 41, 42).

[29] (Neugebauer, and Sachs 1945, 248–250). See (Friberg 1993, 387) who points this out.

[30] J. Friberg uses the school tablets from Ur (UET 7–114 and UET 7–115) that give metrological tables, in which notes specify "for lengths and widths" at the end of the tables containing one of the correspondences and "for heights and depths" at the end of the tables containing the other of the correspondences, and in a colophon of the "tablet of Senkereh" (Friberg 1987–1990, 543; Friberg 1993, 387; Friberg 2000, 156). For this reason, I have called the first tables "table of lengths", and the second tables "table of heights" (Proust 2007b, 107–111).

numbers in place value notation are tools for calculation, and the power of this instrument lies precisely in the fact that the indetermination of the position of the units allows to avoid "*les rompus*" i.e. fractions. But if the scribes did not see a drawback in using a system, in which the "absolute magnitude (of numbers) could remain indeterminate with no inconveniences", why then did F. Thureau-Dangin feel the need to recreate an "absolute magnitude" in his translations? Let us illustrate this with an example:

> Toi, dénoue l'inverse de 32, tu trouveras 1′52″30‴. Porte1′52″30‴ à 36, la hauteur, tu trouveras 1°7′30″ (Thureau-Dangin 1938, p. 35)

.

Here F. Thureau-Dangin gives the symbols degree (°), minute (′), second (″) etc., although the cuneiform text does not contain these marks. This habit of restoring the order of magnitude of numbers written in place value notation is not peculiar to Thureau-Dangin, it is a feature of all the authors studying cuneiform mathematical texts. Why does a way of writing numbers, which did not present any disadvantages to the scribes, prove to constitute a problem for historians from Thureau-Dangin up to now? The question that is raised here concerns the scribal calculation practices. As a matter of fact, the elementary school texts permit us to shed some light on this question and, hence, to understand why it is pointless to substitute our system by the scribes' one in the texts. It is here, we shall see, that lies the interest of considering the school texts and, more precisely, the importance of replacing the metrological tables in their original context. On the basis of the reconstituted collection of mathematical tablets from Nippur, I shall show how the metrological tables establish a relation between the measure systems and the numbers written in place value notation with no indication of magnitude. I shall also show that an analysis of the entire set of school texts permits to grasp how this relation was actually used in calculations.

Grounding his work on a large variety of sources, including the known metrological tables of the time, T. Thureau-Dangin was able to derive some essential characteristics from the metrological and numerical systems in use in the administrative and mathematical texts. But, curiously, his point of view was only partially adopted (as one can see with the example given above i.e. the disfavor of his discoveries on the "table of heights"). Furthermore, he did not deal with the metrological tables as forming part of school tablet lots and consequently, the significance of this context, and in particular the question tackling the way the scribes themselves learnt metrology, remained unknowned to him.

Metrological Lists and Tables in the Studies of Cuneiform Mathematics

From the end of the 1920s onwards, the historians' interest turned to the large erudite mathematical texts. These texts, which came from clandestine excavations and were bought from antique dealers, were starting to flow into the European

and American museums. This new wave contrasted with the previous one in every respect: these tablets, of beautiful appearance but of unknown provenance, displayed an elaborate content revealing to the historians the very ancient roots of mathematics. The cuneiform mathematical texts were first published by F. Thureau-Dangin in the *Revue d'Assyriologie*, followed by O. Neugebauer in the 1930s. These researchers edited most of the texts and defined the terminology that still today represents the core of cuneiform mathematics.[31] The primary sources were mainly gathered in the following books: *Mathematische Keilschrift-texte I–III* published in 1935 and 1937 by O. Neugebauer; *Textes mathématiques babyloniens* published in 1938 by F. Thureau-Dangin; *Mathematical Cuneiform Texts* published by O. Neugebauer and A. Sachs in 1945.

Correlatively the texts, which held the historians attention, were selected for their mathematical content and independently of the contexts they came from. The tablets produced by the schools were generally not studied much for their own sake and among these, some even less than others. Numerical tables were studied (allowing to calculate reciprocals, products, squares, roots), whereas the metrological lists and tables were largely ignored. Many numerical tables can be found among the school texts published by O. Neugebauer in both *Mathematische Keilschrifttexte* and *Mathematical Cuneiform Texts*, but very few metrological lists and tables (only 9 out of the 175 school texts) and no recent edition. The metrological texts, even more than the other school texts, were thought to be too simple, as M. Civil has pointed out (see citation above). This conception of metrological tables is illustrated by O. Neugebauer in the following passage of *Mathematical Cuneiform Texts*, the only passage where the latter mentions the subject at all:

> The teaching of metrological rules was undoubtedly the purpose of many examples in our texts which are very simple from the mathematical point of view but require the mastery of the ratios between various units (Neugebauer, and Sachs 1945, p. 4).

This does not mean that O. Neugebauer was not concerned with metrological problems. Actually, he was the author of a major discovery in this respect i.e. the use of the brick as a unit of volume.[32]

The numerical tables were the subject of careful investigation by O. Neugebauer, who devotes to them the entire chapter I of his *Mathematische Keilschrifttexte*. He examines the tablets' aspect and names the tablets "simple" when they contain only one table, "combined" when they contain several tables; he distinguishes different types of multiplication tables depending on the way they are presented (types A, B, or C); he indicates the formulation of the *incipit*, the presence and content of the colophons, the graphic singularities (*e.g*. writing 19

[31] Among the notable additions to this initial corpus, let us mention the documentation coming from the systematic excavations after WWII, principally the documentation from Susa and Tell Harmal.

[32] In some of the mathematical texts, volumes are expressed in terms of number of bricks of standard format, and not according to the units of volume of the standardized Mesopotamian system (Neugebauer 1935–1937, I: 399; Neugebauer, and Sachs 1945, 94–97).

as 20–1), the terminology, the dating, the provenance. In the plates of *Mathematische Keilschrifttexte II* (plates 61–69), O. Neugebauer reconstructs the general structure of about thirty large recapitulative tablets containing the complete list of standard reciprocal tables and multiplication tables.

Therefore there exists a sharp contrast between the manner O. Neugebauer considers the numerical tables and the way he deals with the metrological lists and tables. The latter do not seem to belong entirely to what O. Neugebauer considers as the mathematical corpus proper. However the metrological and numerical school tablets were found together in the same lots, in comparable quantities, and they are kept in the same museums. As we shall see below, the metrological and numerical school tablets from Nippur are an integral part of the same puzzle, and they shed light on each other.

Metrological Lists and Tables in the "School Archives"

The interest of the historians of mathematics in metrological systems was revived by the work of M. Powell from 1971 onwards, followed by J. Friberg's work on Archaic and Neo-Babylonian metrologies.[33] Several particularly important aspects of the metrological tables were brought to the fore by J. Friberg, as for example, the existence of a specific table for measures of height and depth already mentioned above.[34] So as to integrate these various results into a homogenous and coherent interpretation, it was necessary to replace the metrological tables in the archaeological lots, to which they belonged; this became possible thanks to the extremely important publication work under way.

For the past 20 years, historians have been publishing more and more actively complete "school archives": these archives assemble as far as possible all the texts found in a given place, and in particular the literary and mathematical texts. Some of these publications are "*catalogues raisonnés*" placing the new material at the researchers' disposal.[35] Others reconstitute collections of homogenous provenance and dating on the basis of previously published texts, associated with commentaries and interpretations.[36] Finally, others give new material accompanied by an archival approach.[37] In 2002, less than one

[33] (Powell 1971, 1979, 1987–1990; Friberg 1979, 1993, 1994, 1999).

[34] (Friberg 1987–1990, § 5.1; Friberg, Hunger, and Al-Rawi 1990, 509; Friberg 2000, 156). Besides, J. Friberg underscored the important fact that the metrological table of surfaces can also be used as a table of volumes (Friberg 1987–1990, 543).

[35] See for example the school tablets from Uruk (Cavigneaux 1982, 1996) and from Tell Harmal (Al-Fouadi 1979).

[36] See for example the mathematical school tablets from Ur (Friberg 2000).

[37] See for example the school tablets from Ur (Charpin 1986), from Tell Haddad (Cavigneaux 1999), from Sippar (Tanret 2002), from House F in Nippur (Robson 2001) or from Babylon in the Neo-Babylonian period (Cavigneaux 1981). See also the study of the lexical lists from Nippur made by N. Veldhuis, who has been in a way the promoter of the new approach to the school texts (Veldhuis 1997).

hundred metrological lists and tables had been published since the outset of Assyriology. Soon, with the current publication of the school tablets from Nippur and from Mari, the available documentation will exceed 500 tablets and fragments containing metrological lists or tables.

The Mathematical Tablets from Nippur

In the preceding sections, we examined the way the metrological lists and tables—taken as texts but not as archaeological artifacts—allowed the understanding of Mesopotamian metrology. However, this approach does not answer the questions relative to scribal calculation practices, notably in the school and erudite contexts. We shall now look at these texts from a different angle giving prominence to the material history of the clay tablets which contain the texts. This leads us to the site of Nippur, the place of discovery of the most important "school archives", and hence to the most extensive lot of metrological lists and tables.

The Tablets Excavated by the Babylonian Expedition

More than 800 tablets containing mathematical texts have been found in these "school archives" which were excavated at the end of the nineteenth century by the American mission of the University of Pennsylvania, the Babylonian Expedition.[38] Among them, almost half are metrological lists and tables (more or less 350 tablets and fragments).

The Babylonian Expedition campaigns were managed by a Committee assembling the major institutional (University of Pennsylvania) and private subscribers. This Committee seems to have put constant pressure on the excavators to supply the newly created museum with antiquities and tablets. This context partly explains why the excavators indulged in a genuine "tablet hunt" that had disastrous consequences on the quality of the archaeological work: deep tunnels were dug without consideration for the superficial constructions and surface layers, and with no prior topographical survey; the excavations were led by an important workforce without scientific supervision.[39] Therefore the tablets excavated by the Babylonian Expedition do not benefit from any

[38] The school tablets excavated by the Joint Expedition from 1948 to 1990 are less numerous, and the ones kept in Baghdad are not accessible. Nevertheless, they have the big advantage of presenting a clear archaeological context in comparison with the tablets excavated by the Babylonian Expedition. A complete study of the collections kept in Philadelphia and in Chicago has been published by E. Robson (2001).

[39] Concerning the analysis of the consequences of the Committee's politics for the excavation methods in Nippur, see (Westenholz 1992). See also the account of H. Hilprecht (Hilprecht 1903, 332, 334, 328–329, 339–340).

archaeological context, and it is impossible to know the precise place and the stratigraphic level, in which they were discovered.

Thousands of school tablets were excavated in this way from the deep strata of the site of Nippur. The finds were then brought to Istanbul, where they were split between the American excavators and the Ottoman authorities. The way the tablets were shared out was the outcome of agreements between the two parties within the framework of the laws on the Ottoman heritage, which were promulgated in 1883, permitting a strict control over the movement of antiquities.[40] Hence some of the tablets stayed in Istanbul, the others were sent to Philadelphia. Subsequently, a number of the tablets in Philadelphia were transferred to Jena, where they still are today. This episode, was the result of a conflict between the American excavators. In fact, H. Hilprecht, scientific director of the excavations, was excluded from the University of Pennsylvania because of a difference of opinion with certain of his colleagues of the Babylonian Expedition such as J. Peters, director of the first two excavation campaigns. After his death, his personnal collection was bequeathed to the University of Jena. We shall not enter here into the details of the turbulent history of the Babylonian Expedition.[41] But some aspects of the controversy are interesting to mention in the context of this article. First, a polemic crystallized over the existence of a school in Nippur, this thesis was defended by H. Hilprecht and contested by his adversaries; astronomical and mathematical tablets, in particular examples of multiplication tables, were produced by H. Hilprecht as exhibit in his favor.[42] These events had important repercussions on the conditions of preservation of the tablets, on the fragmentation of the collection into three parts which are kept in different countries, and also on the content of each of them. This controversy was also a major driving force in the diffusion of Hilprecht's discoveries since, according to E. Robson's analysis[43], the publication of the mathematical tablets from Nippur were a response to the numerous attacks on his work.

With the aim of shedding light on some of the selection principles relative to the school tablets, I shall consider two key periods in the history of the sources from Nippur: the sorting processes made by the ancient scribes themselves and the recent sorting operations leading to the formation of the collections in Philadelphia, Istanbul and Jena, in which H. Hilprecht played a major part.

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[40] (Lafont 1984, 179; Hilprecht 1903, 570, 572–574).

[41] B. Kuklick has recently published a book devoted to what may be called the "Hilprecht-Peters controversy", its intellectual context and its consequences for the development of American Assyriology (Kuklick 1996). The two main protagonists have abundantly expressed their point of view in different publications and articles; see in particular (Hilprecht 1903, 1904, 1908; Peters 1905).

[42] See for example, the letters addressed in 1905 to the Trustees of the University of Pennsylvania by J. Peters and by H. Hilprecht (Hilprecht 1908, 14, 35). J. Peters accused H. Hilprecht of lying about the provenance of these tablets.

[43] (Robson 2002, 237).

The Processes of Selection

The collections of school tablets from Nippur which reached us are the result of various kinds of operations of selection, ancient and modern. These selection processes might pertain to the entire set of school tablets, or might concern more specifically the elementary mathematical texts or the metrological texts proper. The protagonists involved in these operations are quite varied: the ancient scribes themselves, the pioneers of Mesopotamian archaeology, the antique dealers, the people in charge of the Ottoman heritage, Americans and Europeans, the historians of mathematics, the curators and collectors, and of course the part played by chance and the ravage of time. The corpus of metrological lists and tables from Nippur bares the mark of the different selection phenomena, to which the cuneiform sources are often subject, and it shows the importance of their impact on historiography.

It is rarely possible, when studying ancient sources, to get an idea—even approximate—of the proportion of tablets that were actually produced at a given time, in a given location. In the case of the school tablets from Nippur, it is nevertheless possible not only to pinpoint some of the selection processes, but also to estimate the way certain categories of tablets may have been filtered.

The first protagonists of these selection processes were the scribes themselves. Close observation of the school tablets shows that the tablets contain many marks of recycling operations: they could be kneaded again, voluntarily broken, agglomerated together in clay containers, incorporated in walls or floors; these tablets were not intended to be kept, but to be destroyed or thrown away. The tablets that have come down to us were found incorporated in building materials (this has in a certain way contributed to their preservation). In some instances, the tablets were abandoned in schools which activities suddenly stopped after a fire or a similar disaster.[44] Further the scribes did not deal with their daily exercises in the same way as certain of the master pieces, which may have been kept and could have circulated from one school to another.[45]

Recycling practices, which consisted of separating the pupils' rough work from the teachers' texts and incorporating this rough work in the building materials led to the unintentional creation of "school archives". The lots of school tablets, which were formed in this manner, are probably representative of the ordinary activity of the school; since one cannot see why the scribes would have gone to the trouble to sort out their rough work before throwing it away. As 10–20% of the rough work are mathematical tablets, this proportion should represent an approximate indication of the number of written texts devoted to mathematics.

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[44] Concerning the practices of tablet recycling and the cases of sudden cessation of the schools' activities, see for example (McCown, and Haines 1967, 64; Civil, Green, and Lambert 1979, 7–8; Faivre 1995; Tanret 2002; Gasche, and de Meyer 2006; Robson 2001).

[45] (Civil, Green, and Lambert 1979: 7–8; Veenhof 1986b).

The work carried out by the Babylonian Expedition also acted like a filter. A first selection was made by H. Hilprecht and the Ottoman commissaries at the time of the tablet share-out in the court of the new archaeological museum in Istanbul. The allotments were not made at random. In H. Hilprecht's own words[46], he took advantage of his knowledge of the cuneiform script to direct the way the tablets were shared out, reserving for the American share the tablets that were of most interest to him, namely the literary and historical texts, and leaving for Istanbul the tablets which seemed to him to be repetitious, namely the administrative texts; a few of the latter would suffice to satisfy the curiosity of the American philologists.

A second process of selection occurred when H. Hilprecht, who kept the tablets that he thought to have the highest value, made up his own collection. And as a matter of fact, the mathematical tablets kept in Jena are in an exceptional state of preservation[47], whereas most of the exemplars in Istanbul are quite disheartening fragments. Of course, the esthetical aspect is not the only criterion of selection that guided H. Hilprecht. For example, a sharp discrepancy can be noted in the share-out of certain types of tablets. One category composed of small "oblong tablets"[48] represents 38% of the tablets in Jena, against 8% of the tablets in Istanbul. It is therefore possible to recognize Hilprecht's personal preferences, which can be related to the collectors' craze for multiplication tables and to the fact that the tables had become the stake of the polemic opposing Hilprecht to Peters.[49] Therefore the categories of texts which are considered important to the modern protagonists can be overrepresented in some museum collections. For this reason, in my investigation into the mathematical tablets from Nippur,[50] it seemed necessary to take into consideration the three collections, which are the result of the different allotments made under Hilprecht's supervision. In this way we obtain a corpus that is as close as possible to the initial lot excavated in Nippur by the Babylonian Expedition.

The American and local excavators also played an active part. What happened to the objects they excavated? In principle everything was sent to Istanbul, where it was to be shared out and inventoried. But the teams of excavators worked in great isolation, lacked scientific supervision and the temptations of the market of antiquities were strong; these circumstances may have had an influence on a specific part of the finds: the most spectacular and the best preserved tablets. Under these conditions, the fact that only a few erudite mathematical texts from Nippur[51] are known to us does not mean that only

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[46] (Hilprecht 1903). Also see (Kuklick 1996: 64).

[47] Concerning the copies and photos see (Proust 2008b).

[48] These tablets – known as "type III tablets" by Assyriologists – were named "oblong tablets" (im-gid$_2$-da) by the scribes themselves. They often contained multiplication tables.

[49] (Robson 2002, 234, 237)

[50] (Proust 2007b)

[51] Out of more than 800 mathematical tablets from Nippur, only three contain erudite texts: CBS 11681, CBS 12648, Ni 5175 + CBS 19761 (Proust 2007b, chap. 7).

a few exemplars were found on this site. One cannot exclude the possibility that the excavators might have found mathematical tablets; subsequently these tablets may have disappeared in the clandestine networks and joined the stream of tablets of "unknown origin" which was to supply the museums of the Occident. On the other hand, the market value of daily exercises was certainly low. This rough work—probably because of its use as building materials—is most often in a fragmentary state. Thus the latter were of little interest to both the collectors and the researchers; many of these tablets are kept in collections containing objects from systematic excavations and forgotten in museum reserve collections.

One can see how at every stage of their history, the mathematical tablets were valued differently by the ancient and modern protagonists. The tablets did not circulate in the same manner depending on whether they were elementary or erudite, fine-looking or fragmentary. The composition of the various collections, which provide our sources, bears the mark of this history.

The last filter is the one made by the editors. After the first period of discovery, in which H. Hilprecht was particularly active, the historians lost interest in the school tablets. The fact is clearly expressed by H. de Genouillac, the epigraphist of the French mission of Kish, who did not bother with the publication of the tablets and merely mentioned their existence, while apologizing for giving a "long inventory" (very useful to us today) of "documents that are chiefly of little interest in themselves".[52] Furthermore, as I have shown at the beginning of this section, the metrological lists and tables have interested historians mainly as a source enabling to establish Mesopotamian metrology, and very little as mathematical or school texts.

Therefore the third section of this article will focus on the school character of the tablets from Nippur. The chosen corpus for this study is composed of the three collections of tablets excavated by the Babylonian Expedition: the ones of Istanbul, Jena and Philadelphia.[53] As it can be seen from the analysis of the various operations of selection which marked the sources from Nippur, this set minimizes the distortion effects due to the modern protagonists. As we shall see, the metrological lists and tables give much more than a definition of measure units. They shed new light on two aspects: the curricula of the scribe's education and the practices of calculation in Nippur.

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[52] (Genouillac (de) 1924 PRAK II: 45; Genouillac (de) 1925)

[53] I have made a complete study of these three collections in (Proust 2007b). I personally studied all the mathematical tablets in Istanbul (which have been published in the above book with the contribution of Antoine Cavigneaux for the lexical texts) and in Jena, published in (Proust 2008b) with the contribution of Manfred Krebernik for the lexical texts. E. Robson very generously put at my disposal her digital photographs and her database relative to the Philadelphia sources. Concerning certain statistical data, I also took into account E. Robson's work on the tablets excavated by the Joint Expedition in the second half of the nineteenth century (Robson 2001).

The Status of School Metrology in Nippur

Curriculum

Some attempts to consider the school tablets as such—i.e. not only for the lexical, philological and metrological information they contain—were made in the early stages of Assyriology. Let us recall how H. Hilprecht paid particular attention to the material aspect of the tablets in his book of 1906, and how he used these observations to show the educational nature of the lexical and mathematical tablets that were discovered by the Babylonian Expedition. Nevertheless, the school tablets as archaeological objects became subsequently of secondary importance. The material aspect of the tablets came back to the fore when M. Civil established a typology of the school tablets on the basis of the sources from Nippur; this typology is widely followed today. It is based on an analysis of the material properties of the tablets and on the existing links between these aspects and the tablets' use in teaching practices.[54] Notably the tablets, known as "type II" tablets, especially numerous in Nippur and already noticed by H. Hilprecht, played an important part in the reconstruction of the scribal curricula.[55]

Consideration of the texts' organization gives another point of view on the "school archives". Assyriologists have revealed structuring elements in the gigantic Sumerian lexical lists which cover the school tablets: catch lines, existence of a doxology[56] at the end of some series, standardized format of items. Let us also mention an Old Babylonian catalogue[57] of unknown origin, which contains an inventory of the lexical lists named by their incipit. The various lexical lists are structured in autonomous units of text, whether the lists are enumerations of cuneiform signs or thematic vocabularies. They have a beginning (the *incipit* given in the catalogue), an end (often marked with a double line, and sometimes with a doxology), and contain a more or less fixed sequence of lemmata.[58] The various lists are autonomous entities, but this doesn't mean that they are completely independent of each other. The Assyriologists who have studied them have shown that they are written in a specific

[54] (Civil, Green, and Lambert 1979, 5; Veldhuis 1999).

[55] In type II tablets, the texts on the obverse and the ones on the reverse are independent from each other and often belong to different categories (for example, a lexical text on the obverse and a mathematical text on the reverse). The text on the obverse consists of the master's model text (left column), and of one or two copies made by the pupil. The text on the reverse is a list which had previously been studied by the same pupil and was reproduced from memory (see figures 1 and 3).

[56] In Nippur, this praise formula addresses Nisaba, the goddess of the scribes: "Praise Nisaba".

[57] Tablet YBC 13617, kept in the University of Yale (Hallo 1982).

[58] The composite text, which was reconstructed from the Old Babylonian sources from Nippur, can be found in the various volumes of the series *Materials for the Sumerian Lexicon*.

order; this order can be established thanks to some of the structuring features (catch lines and catalogue). N. Veldhuis systematically used the correlations between the texts on the obverse and on the reverse of type II tablets to show that this order follows the teaching curriculum. Finally it appears that the instruction in Nippur was divided in two distinct levels: a first level called "elementary" by historians, in which the apprentice scribes studied the lexical lists and were expected to be able to render in writing the lists that they had learnt by heart; a second level known as "advanced", in which grammar and Sumerian literature were studied. The "composite text" of the lexical lists, organized according to the convergent evidence mentioned above, could be a rather good representation of what a young scribe from Nippur had to have memorized by the end of his elementary education. The arrangement of the entire set of texts, which was revealed by the reconstructed curricula, points to the possible existence of an institution.[59] Let us therefore examine how the mathematical tablets fit into this set. We shall see that, considered from this angle, the metrological lists and tables prove to be important, and this is the first reason to reinsert them within the group of mathematical texts.

Studies relative to the typology of school tablets and to the organization of lexical lists developed independently of the research carried out into the mathematical texts.[60] And yet the mathematical school tablets present exactly the same material and textual characteristics as the ones described above with respect to the lexical lists: the same typology, the same structuring elements.[61] Therefore the mathematical texts are indissolubly linked to the lexical texts, and it appears that they must be studied in close connection with the latter.[62] The importance of the metrological lists and tables can be immediately deduced from the fact that they amount to almost half of the mathematical tablets excavated by the Babylonian Expedition. Thus, the status of metrology in the

[59] The issue of the existence of an educational "institution" such as a school is a debate among scholars. The picture is probably very different depending on the city under consideration. The schools of Nippur are perhaps the ones for which the term "institution" is the most suitable.

[60] In order to qualify this affirmation, it is necessary to insist on some studies. As mentioned above (p. XX), O. Neugebauer had identified several types of multiplication tables but, to my knowledge, he doesn't seem to have put his observations in connexion with the ones of H. Hilprecht and E. Chiera. Powell's work lies on the border between mathematics and lexicography, since his interest focused on numerical and metrological notations in the lexical lists (Powell 1971). However, it is a purely philological study, relatively independent from the context of the scribal schools.

[61] This fundamental fact was shown by E. Robson in her study of House F in Nippur (Robson 2001). I then myself systematically pursued this similarity in my study of the sources from Nippur excavated by the Babylonian Expedition (Proust 2007b).

[62] This is what E. Robson has done in her study of 'House F' in Nippur; this study considers the "school archives" as they were found by the archaeologists – without separating the texts according to the various modern disciplines – by investigating jointly the lexical, literary and mathematical texts (Robson 2001).

scribal curricula already appears clearly from a sole quantitative standpoint. But as we shall see more deeply, this status is a functional one.

The school sources show that the metrological lists and tables belong to a large group of structured texts written as enumerations, which constitutes the core of elementary education in the scribal schools of Nippur. The mathematical school texts just as the lexical ones contain an assemblage of these lists including excerpts—of various lengths—of one or more lists. The writing modes of these excerpts reveal, on their scale, how they integrate into the overall architecture, for example in the case of the multiplication tables where catch lines refer one section to another. An analysis of these structural elements along with a statistical study carrying on the correlation between texts showing different features on the obverse and reverse sides of type II tablets permit to reconstruct the curriculum of elementary education i.e. the order in which the lists were written and taught; this analysis is similar to the one made by N. Veldhuis.[63] The apprentice scribe started by learning syllabaries, simple names and then lists of Sumerian vocabulary. It was probably at this point that the pupils began their training in metrological lists and tables, followed by the study of complex cuneiform sign lists and numerical tables, most likely simultaneously. At the end of the elementary level, the scribes studied small texts written in Sumerian (proverbs and legal texts) and probably began learning calculation methods. The possible sequence of mathematical texts at the elementary level is summed up in Table 2:[64]

The mathematical curriculum is nevertheless not entirely clear, and some uncertainties remain. First, although a chronological order can be defined, nothing can be said concerning the duration of the studies or the ages of the pupils at the various stages. Further, the respective position of metrological lists and tables within the curriculum has not been elucidated. I have suggested that these two categories of texts were not intended for the same students. The tables probably belonged to a curriculum more specifically directed towards mathematics. Thus, there would have been not one, but several teaching curricula.[65]

Whatever uncertainties remain on certain aspects of instruction in Nippur, we have a sufficient number of elements to reconstruct fairly precisely a picture of the organization of mathematical education. I have attempted in the following diagram to represent the quantitative and qualitative aspects of these observations (Fig. 4).

In this diagram, the different types of lists are represented by rectangles, the surface of which is approximately proportional to the number of tablets containing the texts—or part of the texts—in question. The diagram gives an idea of the way the mathematical and lexical texts are linked together. The layout

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[63] (Veldhuis 1997; Robson 2001; Proust 2007b).

[64] Concerning the details relative to the textual and statistical studies which enabled me to establish this table, see (Proust 2007b, chap. 5).

[65] (Proust 2007a)

Table 2 Elementary mathematical texts

Metrological lists	list C (capacities)
	list W (weights)
	list S (surfaces)
	list L (lengths)
Metrological tables	table C (capacities)
	table W (weights)
	table S (surfaces)
	table L (lengths)
	table Lh (heights)
Ordinary numerical tables	table of reciprocals
	38 tables of multiplication
	table of squares
tables of roots	table of square roots
	table of cube roots

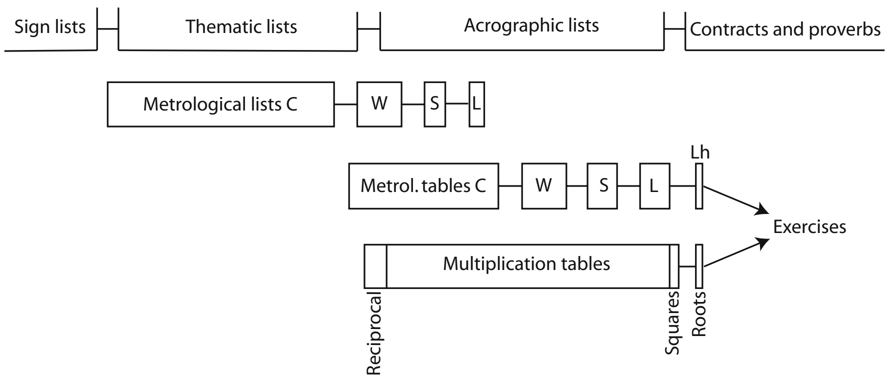


Fig. 4 The elementary mathematical curriculum in Nippur (Proust 2007b, 152)

renders the chronological sequence of the mathematical and lexical training (i.e. lists and tables) and the connections between the various texts that are mentioned by our sources, in particular the type II tablets. The three series of mathematical tables (metrological tables, ordinary numerical tables, tables of roots) form a comprehensive group, but a consideration of their statistical frequency indicates that only a relatively small proportion of the scribes from Nippur actually had the opportunity to study and assimilate the entire group of texts. As for the lexical lists, the "composite text" formed by these tables is a good representation of the set of structured results that the scribes of Nippur had to memorize, at least the ones who had attended the elementary mathematical curriculum to the end.

Elementary level mathematics was followed by an advanced level, just as it was the case for the instruction in writing and in Sumerian. The advanced level

in mathematics mainly consisted of calculation exercises in multiplication of numbers in place value notation, in finding reciprocals, and in surface calculations of squares and rectangles of given side. All these exercises were done on tablets known as “type IV” tablets, i.e. small square tablets, strongly convex on the reverse. Now what is the relation between the tables assimilated at the elementary level and these advanced level exercises?

We can presently draw a first conclusion from the texts studied in this article. The typology of the tablets, the organization of the texts and the statistical data provide information permitting a reconstruction of the scribal education: a possible specialized curriculum, the learning order of the lists, the interrelation between the different subjects, the teaching methods. Therefore, one can see how the “archival” approach to the lots of tablets found by the archaeologists shows their coherence. More importantly for us here, it also reveals the central and fundamental part played by the metrological lists and tables in this context. Let us now consider how the interpretation of other mathematical texts may benefit from this new understanding, in particular the comprehension of the advanced exercises. This is the second reason to reinsert the lists and tables in their original context.

Practices of Calculation and Conception of Numbers

Let us examine more closely how the mathematical school tablets from Nippur allow to grasp the calculation practices and the conception of numbers that were taught to the scribes. Concerning the elementary level, this content can be approached in two different ways. First, the “composite text” can be considered; it informs us on the data memorized by the scribes. Second, one can examine the manner in which the various parts of the memorized text were inscribed by the pupils on the clay tablets; this last approach, as we have seen, informs us more particularly on the way the tables were taught. Concerning the advanced level, the situation is different because the texts are not standardized. Therefore, we are unable to reconstruct a “composite text”, which could help us understand how the texts interrelate. These calculation exercises are all different and this indicates that the authors were more autonomous. In the following lines, I shall show how the elementary mathematical tables were used to learn calculation techniques given in the exercises at the advanced level.

As we have already mentioned, the first stage of the mathematical education was based on metrological lists with the aim of transmitting the principles of writing measures. The lists show how to represent practical quantities in writing. This knowledge was indispensable for the ordinary operations of accounting and administration, in particular balance sheets, and therefore must have been taught to all the apprentice scribes. This is substantiated by the large proportion of lists of capacity measures in the lots of tablets from Nippur.

The metrological tables introduce another dimension, which is expressed visually by two sub-columns on the tablets. To each measure written in the left sub-column corresponds a sexagesimal number in place value notation, written in the right sub-column. As we have already underlined in section "description of sources", the tables reveal two types of numbers: the ones on the left, which are governed by an additive principle, are used to express measures; the ones on the right are given in place value notation with no specific order of magnitude, they are "abstract numbers" in the sense that they are not accompanied by units of measure. Therefore the metrological tables have a double function: first, similarly to the lists, they contain all the information connected with the numerical and metrological writing systems in use during the Old Babylonian period in almost all of Mesopotamia; second they establish a relation between measures and abstract numbers.

The numerical tables follow the metrological tables in the curriculum. They contain a listing of many elementary operations (reciprocals, products, squares, square roots, cube roots). Let us stress two essential traits of these tables: (1) They are exclusively written using abstract numbers; (2) they only give operations of multiplicative nature (multiplication, calculation of reciprocals and derived operations mentioned above). Now there is a clear link between these two traits: the multiplicative operations do not require knowing the position of the units; and calculations of reciprocals are even greatly facilitated by a notation using numbers with "floating value".

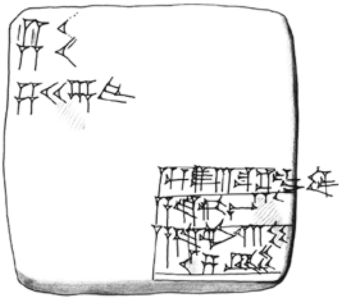
The curriculum continued with series of exercises in multiplication using abstract numbers, followed by calculations of reciprocals of regular numbers (numbers, which reciprocal can be written in base 60 with a finite number of positions[66]), also using abstract numbers. These exercises clearly show a tight link between abstract numbers and multiplication/calculations of reciprocals.

The next stage was devoted to the calculation of surfaces. Six tablets of similar aspect and content found in Nippur[67] show the coherence of this pedagogic system. These tablets are square tablets that give in the lower right corner a small text written in Sumerian, and in the upper left corner a multiplication using abstract numbers. Figure 5 below shows an exemplar.

A first remark ensues from a superficial examination of the text: the measures given in the small text in the lower right corner are just as they appear in the metrological lists and in the left sub-column of the metrological tables (numerical values written using an additive system followed by a unit of measure); the numbers written in the upper left corner are as they appear in the right sub-column of the metrological tables and in the numerical tables (abstract numbers). If we examine more closely the numerical data of the text, we see that the relation between the measures (lower corner) and the abstract

[66] They are therefore products of powers of divisors of the base (2, 3 and 5).

[67] Five of them have been published in (Neugebauer, and Sachs 1945, 246–251) ; the sixth Ni 18, which is represented here (figure 4), has been published in (Proust 2007b, 193, pl. I).



Translation

2.10
2.10
4. 26^{sic}.40

1/3 kuš$_3$ 3 šu-si the side (of the square).
What is its surface?
Its surface is 13 še
1/4^{sic} še.

Fig. 5 Tablet Ni 18, Museum of Istanbul, copy by C. Proust

numbers (upper corner) is the one given in the metrological tables.[68] Therefore there is a fundamental link between the different elementary mathematical texts, and we understand the importance of reading the tables and the other texts together. Further, the layout of the text on the tablet reveals that the separation between the measures on one side and the abstract numbers on the other is analogous to the one noticed in the metrological tables. The tables' structure induces us to pay attention to the layout of the exercises, which had never been considered in the publications connected with these tablets. Thus it is manifest that the metrological tablets constitute a tool for the calculation of surfaces. One can see the link between the data stored in the elementary tables (and memorized) and the calculation practices; the latter implying the need to constantly switch back and forth between the notation of measures and the multiplicative calculations with abstract numbers. The way the exercises of surface calculations are organized on the tablet clearly shows that the instruction particularly stressed the difference between these calculation stages. This method of calculation is illustrated in the Fig. 6 below:[69]

The lengths of the sides of the square written in the lower corner are transformed into abstract numbers using the metrological tables of lengths (1); the abstract number found is written in the upper corner (2); the multiplication of the number by itself is made using the multiplication tables (3); the product found is placed below the two factors (4); this abstract number is transformed into a surface measure using the metrological tables of surfaces (5); the measure found constitutes the solution to the small exercise (6). Let us remark that reading the tables from left to right does not give rise to any

[68] This is true for the six tablets from Nippur, including the one giving a calculation mistake in the multiplication, indicated by "sic" in the translation.

[69] Figure taken from (Proust 2007b, 251).

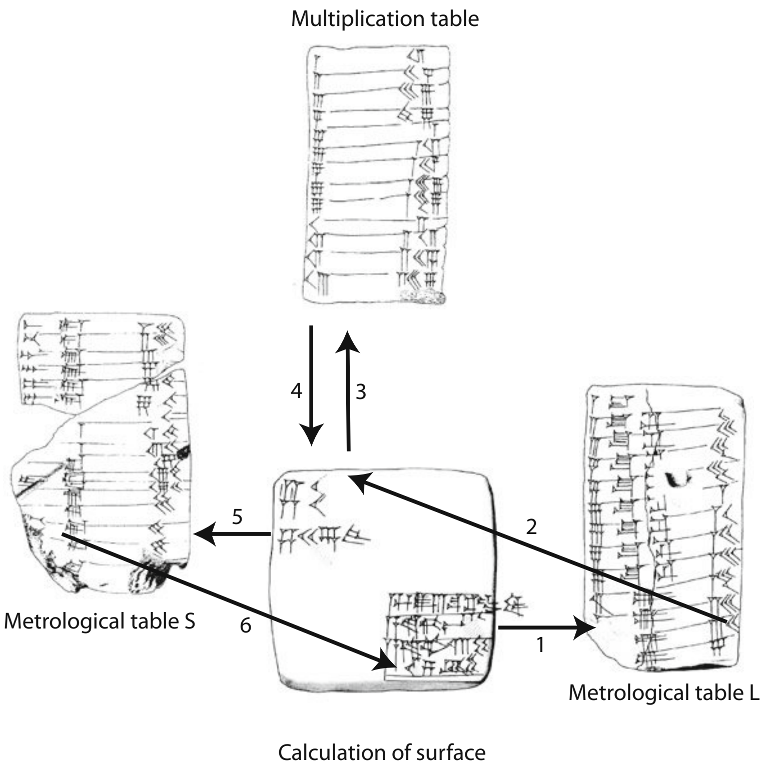


Fig. 6 Calculation of a surface

difficulties, while the reading from right to left requires much mental control to deal with the orders of magnitude.

Figure 6 illustrates an essential aspect of the corpus of school texts from Nippur: all the texts are closely linked together, each one occupying a precise position in an elaborate mechanism of calculation. For the historians today, this represents a large puzzle, where each piece is necessary for the comprehension of the whole. Without the metrological tables, which constitute the key pieces, the puzzle could not reveal a discernible image.

As it has now been reconstructed, this mechanism allows us to answer a number of questions with respect to the calculation practices of the scribes. The mechanism is based on the separation between the different functions of numbers: the role of quantification is expressed by numerations using additive principles, and the role of multiplicative calculations is covered by a sexagesimal numeration in place value notation with no order of magnitude. Under these conditions, we understand that locating the units' position of abstract numbers is useless: numbers in place value notation are not quantities, they only serve as tools for multiplicative calculations and calculations of reciprocals.

Calculation using numbers with “floating value” is no inconvenience; on the contrary, it gives an extraordinary power to this tool. There is no reason for the modern historians to complicate their calculations by substituting a modern system cluttered with zeros for the very effective ancient system.

We see how the metrological lists and tables, first used to establish the Mesopotamian metrology and then marginalized during the period of discovery of the great mathematical texts, finally prove to be an essential part of the calculation mechanisms taught in Nippur. These mechanisms are based on the delimitation of two distinct numerical universes, the one devoted to measures and counting, the other devoted to calculation in the multiplicative field. The metrological tables permit the constant switching back and forth from the one to the other. Thus the mathematical school texts from Nippur form an extremely structured and functional group, of which no part should be neglected if we wish to understand its meaning. This structure gives us information not only on the scribal curricula, but more importantly on the fundamental notions that the master scribes taught to their pupils. These texts, when considered in a coherent way, shed light on several important aspects of the background of the erudite scribes.

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What Shaped Our Corpuses of Astral and Mathematical Cuneiform Texts?

David Brown

Assyriology has much to offer any discussion on the shaping of a corpus of mathematical, astronomical, astrological, or astral-divinatory texts. Firstly, the scholarly milieus in which the texts were first composed, the manner in which they were collected, or stored in antiquity, and the survivability of the materials upon which they were written all served to ensure that the texts that *might* have survived were very different to those that might have survived from ancient China, Greece, or India, say. Secondly, the knowledge of how to read cuneiform script was lost in antiquity and Assyriology grew out of its decipherment beginning in the mid-nineteenth century, and there is an important story here to tell of the national, institutional, scholarly, religious, and personal agendas that have shaped the formation of our corpuses of cuneiform texts ever since. Those modern forces were not, however, monolithic, but varied from subject matter to subject matter.

Here, I trace first those modern agendas that led from what arrived in our museums to our current corpuses of astral and mathematical cuneiform texts. Thereafter, I discuss the ancient practices that initially shaped what might have been bequeathed the modern era, only a tiny fraction of which actually made the transition from clay to paper in the nineteenth, twentieth and twenty-first centuries CE. I attempt to show throughout how an awareness of both the ancient and modern agendas can help us better to contextualise the materials we have, and to avoid reading too much or too little into them. I am able, therefore, to suggest directions for future research on those texts that have not yet been edited and which languish in our great museums.

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F. Bretelle-Establet (ed.), *Looking at It from Asia: The Processes that Shaped the Sources of History of Science*, Boston Studies in the Philosophy of Science 265,
DOI 10.1007/978-90-481-3676-6_9, © Springer Science+Business Media B.V. 2010

Modern Agendas that Governed Which of the Surviving Texts Were Used to Formulate A Corpus

Initial excavations in Mesopotamia and surrounding regions where cuneiform was used, were geared more to filling western museums than to the reconstruction of an ancient series of civilisations. A vivid description of this process is offered by Larsen.[1] The so-called "scramble for antiquities" ended shortly before the beginning of the twentieth century, as exemplified by the scientific excavations then begun in Babylon, Nippur, and Nineveh. However, the majority of the material upon which our understanding of cuneiform astral science is based was collected illegally prior to this period. The situation with regard to the texts of a mathematical nature is similar.[2] Texts purchased on the open market are usually the best pieces found, the smaller fragments having been discarded as valueless. Only a tiny percentage of the textual material dug up ends up making its way to a museum, and once there primitive storage techniques of the period meant that many pieces disintegrated. As a first approximation, therefore, nineteenth century museum practice and attitudes towards antiquities from the orient ensured that our corpuses of astral and mathematical cuneiform texts begin as little more than an unprovenanced box of sizeable, decaying tablets.

The early years of Assyriology were often colored by nationalistic, one might even go so far as to say racist tendencies[3] and religio-political agendas, and the backlash to these. Both had profound effects on the study of the history of science as made evident in cuneiform texts. Where the earlier years of the discipline were characterised by excessive claims, wild speculation, and populism particularly when it came to texts of a religious nature, but also when it came to texts of an astrological and astronomical nature, they were, at least underpinned by a desire to determine the relevance of the cuneiform material for the classical and European worlds. This changed in the 20s. The backlash led to a more rigorous discipline with its own categories, jargon, and methodologies, but led to Assyriology having a lower profile, greater incommensurability with other disciplines, and to an attitude that the cuneiform material should be studied "for its own sake", with important consequences for the corpuses of texts we are concerned with here. For example, the "own-sakism" of Assyriology has, I propose, helped in the formation of a fallacious attitude that cuneiform astronomy was a "closed chapter in the history of science." This, in turn, governed which astral texts were studied first. I outline this development, below.

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[1] (Larsen 1996)

[2] (Robson 2000, 94).

[3] See, for example, Veldhuis' comments on (Veldhuis 1997, 6–7).

Astral Science

Cuneiform tablets found their way to Western museums during the second half of the nineteenth century in a haphazard fashion, where they were stored, lost, hidden, displayed and translated with varying degrees of success over the ensuing decades. Tablets in Western museums with pre-zodiacal astrological content from Nineveh were first translated and discussed by Sayce in 1874. From 1872, thousands of cuneiform tablets from southern Mesopotamia, Babylonia, began to appear on the market in Iraq and many found their way to London and the British Museum. There, from 1878–1881, Strassmaier strove to assemble the new data, and sent texts with a strongly numerical content, and accompanied by dates, to Epping who by 1881 was able to publish a short analysis of a lunar ephemeris, identify the logograms for the planets and find the Julian equivalents to the Seleucid era dates.[4] Here was an astral science of a different order to that which had been published earlier by Sayce. Epping continued to work on the material, publishing a monograph in 1889, which was rapidly followed by volumes written by Kugler on similar material, for the most part astronomical. Their discoveries were, according to Swerdlow,

> The most important, the most revolutionary in the entire study of science in antiquity, perhaps in the entire study of the history of science.[5]

It has taken until the last decade for us to realise this, however, and such knowledge is still not widespread. One major reason is, I suggest, because the discoveries of the Assyriologists were wrapped in a jargon that made them barely accessible to the wider scholarly community. Epping and Kugler's publications, for example, require a mastery of Akkadian and Sumerian as well as a good grasp of the mathematics of naked-eye astronomy to be understood properly. More importantly, however, those historians of science who in time came to work on the material approached it with particular agendas which misrepresented its true import. In short, the significance of the astral sciences was underestimated, and that of the mathematics overestimated, so far as the influence of those subjects on those in subsequent cultures was concerned. These agendas determined which texts were chosen to be edited first, and came to define the corpuses we now work with, but why did it happen?

The often-brilliant work of these historians of science has had almost no impact on mainstream Assyriology. Only in recent years have attempts been made in both cuneiform astral science and mathematics to place those fields within their cultural, social, and intellectual contexts. For many Assyriologists, the Hellenistic period is the limit of their temporal horizons, despite the fact that it was around this time that astral science began to flower in the land and to spread throughout the entire world. Babylonian astral science is the greatest of

[4] (Neugebauer 1975, 349).

[5] (Swerdlow 1998, 2).

the many Mesopotamian cultural legacies to the classical, Partho-Sasanian, Indian, and West Semitic worlds, and thereby to the modern period. Yet it remains, to this day, outside the standard repertoire of university teaching in Assyriology.[6] Clearly, this has had a huge impact on those texts chosen to be edited.

Alongside the rigorous work of Epping and Kugler, a far more popular "pan-Babylonianistic" doctrine emerged. This strange episode in humanistic, particularly German humanistic, scholarship drew on the work on comparative mythology pioneered by the likes of Eduard Stucken (1896–1907), but was rapidly taken over and expanded, so far as Assyriology was concerned, by Jeremias (1911 and 1913), Winckler (1904 and 1907), and Jensen (1890, 1906). These scholars read into the newly deciphered literary cuneiform texts all sorts of astral meanings, deduced thereby a too-sophisticated level of Mesopotamian understanding of the workings of the heavens, and over-estimated the debt all subsequent mythology owed Babylonia.[7] Although methodologically unsound (cf. Kugler's critique in 1910), pan-Babylonianism inspired a heightened interest in cuneiform astrology and astral divination, the reaction to which had important consequences for our current corpuses of these types of text.

Neugebauer writes that the disputes vanished from the scene after the First World War, "as if they had never existed".[8] His celebration of the end of this "doctrine" is crucial, for it reflects a view that implicitly supported the lack of contemporary and widespread relevance of the extraordinary cuneiform astronomical material, as he saw it then. Rather, when it comes to cuneiform astral science, he writes:

> We are very far from any "history" of Babylonian astronomy and must be satisfied to accept it as a completed system of admirable elegance and efficiency but without really understanding its development....For the modern historian of "ideas" Babylonian astronomy is no pleasant hunting ground....And for the purely historical question how such details could reach astronomers in Alexandria or Ujjain he will find no answer....it is a rather self-contained problem of great technical complexity.[9]

For Neugebauer in 1975 cuneiform astronomy was what I am terming a "closed chapter in the history of science." At that time he devoted little thought to its emergence from the background of astral divination (a discipline using astral omens and usually for the king), and astrology (the deriving of interpretations from the calculated positions of the planets and usually for private individuals). He minimised their role in the development of subsequent astral science. We understand both the development of cuneiform astral science far

[6] E.g. two of the history text books most commonly used by undergraduates of the Ancient Near East Kuhrt 1995 and Van De Mieroop 2006 end their surveys in around 330 BCE. Many further examples could be given.

[7] For a near-contemporary take on pan-Babylonianism, see (Toy 1910), and for a modern reappraisal see (Larsen 1995).

[8] (Neugebauer 1975, 349).

[9] (Neugebauer 1975, 348).

better now, and much more about its deep influence on the predominant forms of Greek and Latin astronomy and astrology up to the third century CE. The prevailing view had been, and in many quarters still is, that astronomy in Greek was not derivative and for the most part spherical-trigonometric, as exemplified by the works of Ptolemy in the second century CE. This is not so, however. Interestingly, van der Waerden had suggested in 1947 and 1956 that Babylonian astronomical methods had made their way to Egypt, a view wholly vindicated in the light of modern research, but his views fell on deaf ears until recently. Part of the change of perspective was brought about by Neugebauer himself in one of his latest publications[10] – a Roman-period astronomical table from Egypt written on papyrus in Greek but containing values taken from a Babylonian lunar scheme.

Treating cuneiform astronomy as a "closed chapter", that is, as something of interest, but not central to any of the stories being promulgated as to how "science" in a Western sense emerged, meant that any view as to what lay behind its invention could prevail. Two in particular dominated: firstly that its purpose was to help control the lunar calendar, and secondly that the cuneiform scholars had an interest in prediction for its own sake. This was a model derived from more recent preconceptions as to how modern science comes about, and was first imposed anachronistically on the ancient Greeks, and then used again to explain the origin of cuneiform astronomy. Needless to say, it was wholly inappropriate, but it helped ensure that until recently only certain types of cuneiform astronomical texts were considered worthy of study, where others, of an apparently more astrological nature were little regarded. Indeed, the evidence that now exists from Mesopotamia as to why cuneiform astronomy developed as it did provides the opportunity for returning the compliment, and proposing that similar motivations underlay the creation and development of early astronomy in the Greek language.[11]

In my view, and in line with the backlash to pan-Babylonianism and its over-excessive claims of Mesopotamian influence, Neugebauer minimised the Babylonian contribution to Graeco-Latin astral science in the following ways. On astrology he wrote:

> Astrology became known to the Greeks in the hellenistic period. But with the exception of some typical Mesopotamian relics the doctrine was changed in Greek hands to a universal system in which form alone it could spread all over the world.[12]

His view as to the influence of cuneiform astronomy was similar, but I turn to that below. First astrology is considered: The work of Rochberg on the Babylonian astrological material has done much to increase the number of

[10] (Neugebauer 1988).

[11] (Brown in press IAAS).

[12] (Neugebauer 1975, 613). It must be understood that Neugebauer's stunning publication of 1975 summarised the views he held on ancient astronomy that he had been formulating and reformulating since the 1930s. He was to continue to reformulate them thereafter.

these "relics", however, and my own work[13] on the horoscope in cuneiform and West Semitic (Qumran) sources suggest that this too was a Babylonian invention, despite the consensus that holds it to be a Greek creation.[14] The extent of the Egyptian content of the astrology that was practised during the Roman period of rule in Egypt has also become clearer of late. It would appear that Babylonian astral science fell on fertile ground in Egypt at some point from the Saite (ca. –600) period on, and was taken up into the Egyptian script Demotic, embellished with particularly Egyptian notions, and then found its way into Greek.[15]

The notion, therefore, that only the Greek version of astrology could spread over the world was too hasty. The Babylonian "version" travelled with ease to Egypt, and hints survive that it also travelled directly to Greece and Rome.[16] The Egyptianized "version", however, was particularly attractive to Greek and Latin speakers, and found its way to India. The core idea of this astrology, being that the configuration of the heavenly bodies, be they invisible or visible, at birth or conception, could provide information on the future of the native, was purely Babylonian. A means by which the configurations were calculated, arithmetic astronomy, was first perfected in Babylonia and was not bettered in terms of accuracy until the second century CE. The values assigned to the planets in terms of their malefic or beneficient properties, the notion that their angular relationships were of significance, that their positions within the signs of the zodiac had meaning, all this and much more were Babylonian. All subsequent zodiacal astrology was a mere embellishment of these fundamental ideas.

Neugebauer's attitude (as expressed in 1975 and earlier)[17] towards Babylonian astrology reflected a widespread attitude towards this "wretched subject" (discussed by Neugebauer himself in 1951), which on the one hand was connected to a particular view as to what a "proper" science should concern itself with, and on the other was part of the backlash to pan-Babylonianism.

If we put aside the many publications of Jeremias, Winkler, and Jensen, with their often populist and excessive claims as to the influence of cuneiform religion and astral science, the period up to the 1920s still included the following major publications on cuneiform astrology:

– Bouché-Leclercq's 1899 book, the second chapter of which is devoted to Chaldaean (Babylonian) astrology as determined from classical and the recently deciphered cuneiform sources. It was indebted to Jensen 1890,

[13] (Brown in press IAAS).

[14] (E.g. Pingree 1997, 26–8).

[15] (Quack, in Brown in press IAAS).

[16] (Pingree 1997, 23–4).

[17] Swerdlow tells me that Neugebauer was well aware of the importance of astrology for the development of astronomy, despite what he wrote in 1975.

but also mentions the works of Strassmaier and Epping (mentioned above).[18]

- The works of Boll, Bezold and Gundel, listed in the Bibliography.[19]
- The works of Cumont up to 1912.

In other words, up to ca. 1920, the question of the relationship between Babylonian and Greek astrology was of such significant concern to scholars as to merit a row of publications, and to merit the co-operation of experts in cuneiform (e.g. Bezold) and classicists (e.g. Boll). A major reason for why such questions largely ceased to be of concern was the reaction to the excessive claims of the previous generation of scholars.

However, a seed for what I see as the other major cause for the reduction in the interest of serious scholars in cuneiform astrology was sown by Cumont, himself, who felt free to write:

> The insatiable curiosity of the Greeks, then, did not ignore astrology, but their sober genius rejected its hazardous doctrines... it is to their everlasting honour that, amid the tangle of precise observations and superstitious fantasies which made up the priestly lore of the East, they discovered and utilised the serious elements, while neglecting the rubbish.[20]

While we should not rush to tar Boll, Bezold, Gundel, and Bouché-Leclercq with the same brush, Cumont's views do point to an attitude towards the astrological material that characterises the work of many scholars, namely that the "Greeks" were aware of Babylonian astrology, but more interested in astronomy. Even as the extent of Greek interest in astrology became clear with the publication of the *Catalogus Codicum Astrologum Graecorum*, for example, begun under Cumont's editorship in 1898 and completed in 1953, the view still prevailed that Greek astrology and astronomy represented distinct areas of interest, and it is clear which one was held in high regard. At best, the modern study of ancient astrology was felt to be useful in revealing historical links. This is Neugebauer's attitude in his comment in 1951 on Sarton's review of E. S. Drower's *Book of the Zodiac*. Sarton's attitude had been to denigrate the relevance of the entire field of astrology, where Neugebauer's was to stress its importance as an historical tool. Nowhere in this short article, though, is there any recognition of astrology's role in stimulating and maintaining development in astronomy, and, most importantly, in accounting for astronomy's spread from the royal to the private domain, and thus far beyond Babylonia, including to the Greeks.

I contend that Sarton's and Neugebauer's attitudes towards the (in)significance of astrology in the history of science cohered with a wider rejection of pan-Babylonianism, and did affect the study of the cuneiform astral material. It

[18] (Bouché-Leclercq 1899, 41 n. 1).

[19] Boll & Gundel 1937 was a much delayed publication.

[20] (Cumont, 1912, Introduction).

is exemplified by the extraordinary attitude the British Museum curators had towards the copies of texts of astral science made by Pinches between 1895 and 1900, which were kept secret until the 1950s, and by the fate of Strassmaier's notebooks in which many of the relevant BM accession numbers of such texts were listed. The latter languished in the Pontifical Institute in Rome for decades until P. A. Deimel handed them on to Neugebauer.[21] Neugebauer had laboured on cuneiform mathematical and astronomical texts through the late 20s, 30s, and 40s, always interested in their possible relationships with classical mathematics and astronomy. The astrological material did not interest him, however. The Assyriologist Abraham Sachs joined him at Brown University and in part filled that gap. In 1953 and 1954 Sachs worked in the BM, using the Pinches' copies and Strassmaier's notebooks, and the result was the important 1955 Pinches-Strassmaier-Sachs, *Late Babylonian Astronomical and Related Texts* (LBAT). This book provided copies of some 1350 texts of astral science, with a catalogue of 1648 texts, mostly but not exclusively held in the BM, listing their contents (mostly very laconically), organised into the following genres:

Mathematical Astronomy (Nos. 1–159)
Astronomical Diaries (Nos. 160–994)[22]
Normal-Star Almanacs (Nos. 995–1116)
Almanacs (Nos. 1117–1212)
Goal Year Texts (Nos. 1213–1367)[23]
Planetary and Lunar Observations (Nos. 1368–1457)
Horoscopes (Nos. 1458–1476)
Miscellaneous Astronomical Texts (Nos. 1477–1493)
Instructions for Construction of a Gnomon-Like Instrument (Nos. 1494–1495)
Mul.Apin (Nos. 1496–1498)[24]
Zwölfmaldrei (Nos. 1499–1500)[25]
Ziqpu stars (Nos. 1501–1514)[26]
Intermediate Astronomy (Nos. 1515–1520)
Enūma Anu Ellil (Nos. 1521–1577)[27]
Late Astrology (Nos. 1578–1630)
Mathematics (Nos. 1631–1648).

Translations there were none, except that all 159 astronomical texts appeared virtually contemporaneously, fully translated and edited by

[21] (Neugebauer 1975, 351).
[22] A day-to-day record of celestial and other happenings.
[23] Almanacs and Goal Year Texts derived predictions for the planets mostly on the basis of a database of observations (such as the Diaries) and characteristic intervals after which the planets repeated earlier configurations.
[24] A two-tablet series of ideal astral schemes and omens – see Hunger & Pingree 1989.
[25] Texts that link months with rising stars.
[26] Texts listing culminating stars, used for timing at night.
[27] The great celestial divination series of about 70 tablets.

Neugebauer in his three volume 1955 *Astronomical Cuneiform Texts*. Indeed, the order assigned to the texts in LBAT pretty much reflects the order of their subsequent publication, and this is a good measure of the order of significance assigned to the material by the scholars who worked on them up to 1955 and since. Since 1955, the dated Astronomical Diaries (Nos. 160 to 523) and some of the Eclipse and Planetary Records (Nos. 1413a to 1492, except 1484, 1489, 1489, and 1491) have been published in their entirety, despite their great linguistic difficulty. Some of the horoscopes had been treated by Sachs in the early fifties, and although they are of seminal importance for the history of relations between Mesopotamia and its neighbours and fundamental to an understanding of why astral science developed as it did there and in Egypt, Greece, Iran, and India, in particular, they were pretty much dismissed by Neugebauer and van Hoesen[28]as irrelevant to both, given the few that have survived. It is, in fact, a miracle that any survived given the origin of our sources in the nineteenth century looting of the Babylonian temples and that horoscopes were made for private individuals who would, one would suspect, ordinarily have taken them with them. Not until 1999 were all the horoscopes known properly edited by Rochberg (including LBAT Nos. 1458–1476).

Many of the Almanacs and Goal Year Texts have been published.[29] The tablets pertaining to the celestial divination series, Mul.Apin and *Enūma Anu Ellil*, have also been published in recent years.[30] However, these series were not the product of astral practice taking place in the last few centuries BC, as are all the others in LBAT. They were formed in the second millennium BC, and the tablets amongst the LBAT texts with excerpts from them were simply late copies of copies, etc. They have been selected for publication by modern Assyriologists working on editions of the series, using for the most part more ancient material. The dates of their publication do not, therefore, reflect the interests and agendas of modern historians of ancient astral science.

Relevant to our discussion, however, is the fact that Sachs lists well over 50 texts of late astrology, only a few of which have been published to date. Some were touched upon in the early, pan-Babylonianistic days of the discipline, and the editions are consequently very dated. Most importantly, there still exists no edition of *all* these texts, and of the many new ones that have come to light since 1955, little attempt has been made to place them within the context of late Babylonian society or within the context of cuneiform astronomy. This is, to say the very least, disappointing, and I suggest that it reflects the concerns of those historians of science for whom non-astronomical astral science is viewed as "wretched," "rubbish," or as little more that an "historical tool".

Abraham Sachs was an eminent Assyriologist whose detailed knowledge of the surviving "corpus" of texts of astral science of the late period was unrivalled.

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[28] (Neugebauer & van Hoesen 1957, 161–2).

[29] (Hunger & Pingree 1999, 159–170) lists the publications.

[30] (Brown 2006, n. 23) for a list of publications.

By 1948 he had produced the classifications into Diaries and Goal-Year Texts, and so forth, listed above, upon which we still rely. He was the establisher of many of the modern "corpuses" of cuneiform astral science, but he died long before his ambition to publish editions of all of this material was realised. Despite the efforts of Rochberg and occasionally Hunger[31] we are still relatively poorly informed about late Babylonian astrology, and far better informed about the details (but not the purpose) of late Babylonian astronomy, upon which a large number of scholars have worked and continue to work. Rather than list these modern scholars, I refer the reader to the bibliography in Hunger & Pingree (1999).

This state of affairs has had a significant impact on our (mis-) understanding of cuneiform astral science. It has helped bolster the false idea that cuneiform astronomy is of little relevance to the subsequent development of astral science, and that its motivation was calendrical and/or based on the personal scientific interests of scholars. Neugebauer wrote in 1975 that no trace of the most advanced parts of Babylonian lunar theory had been found in Greek astronomy:

> A strong argument in favour of the opinion that not much more than some basic parameters were transmitted from Mesopotamia to the West.[32]

In 1988, as noted above, however, his views began to change. Since then, thanks mainly to the fabulous discoveries made in the Oxyrhynchus collection of papyri,[33] we now know that much, if not all, of Babylonian astronomy and astrology was very familiar to astrologers based in Egypt from ca. –50 on, writing both Greek and Demotic. Furthermore, very few of the Roman period Egyptian papyri concerned with astrology have been published to date (as noted above, and no doubt for the same reasons as with the cuneiform astrological material, because it is "wretched"). We are aware, though, of the existence of many such texts scattered throughout western collections, and their importance for showing the persistence of both Babylonian and Egyptian astrological, and thus astronomical techniques, in the classical world is yet to be fully evaluated.

We are able to state, however, with some confidence, that the "Greek Astronomy" of the spherical-trigonometric variety devised by Hipparchus and developed by Ptolemy, represented but a small fraction of the astronomy that was actually done in Greek up to the third century CE. Most Greek astronomy was arithmetic using methods either directly copied from Babylonian or adapted therefrom, and in this the Greeks were no different from the Iranians, the Egyptians, those speaking a West Semitic language, the Indians, and so forth.[34] This transmission of intellectual knowledge had enormous

[31] (E.g. Hunger 1999; 2004).

[32] (Neugebauer 1975, 829).

[33] (E.g. Jones 1999).

[34] For details see (Brown in press IAAS).

ramifications for attitudes towards the gods, chance, fate, the place of the individual in the cosmos, and so forth, but has not been appreciated for the best part of a century. If we define our current corpus of cuneiform astral texts as the collection of reliably edited cuneiform texts extracted from the boxes of (for the most part) illegally excavated tablets, that corpus would look very different today, had the significance of this transmission of astral knowledge been understood sooner.

To take an example, the so-called cuneiform "planetary ephemerides" date predominately to the Hellenistic period, and were amongst the first studied by Epping and Kugler, mentioned above, and the first to be presented in modern editions, with all then-available exemplars included.[35] These ephemerides calculate the dates and times of planetary phases – their heliacal risings, stationary points, and so forth. Very few provide the means to calculate the location of a planet at any given moment, precisely what is necessary for drawing up a horoscope. It has always, then, been easy to assert that the purpose of the ephemerides had nothing to do with personal horoscopy. There are ephemerides for Jupiter and Mercury, however, which interpolate planetary positions between phases on a daily basis. We term these "day-to-day" or "daily motion" ephemerides.

Neugebauer (1975: 412) notes that their purpose could have been to solve the "astrologically important question of a planets' crossing from one zodiacal sign into the next," but also states that one "may even think of purely mathematical interest". This latter suggestion seems far-fetched today, given the context in which those self-same astronomical methods were used in Egypt, and given the context in which the ephemerides were found, namely together with astrological texts, which needed precisely this kind of information in their construction. Neugebauer was able, though, to propose such a modern motivation as "mathematical interest" (a) because of the loss of archaeological provenance of the texts he was considering, due to the excavations of the nineteenth century and the attitudes of the then museum curators, (b) because such proposed motivations were at that time legitimate within the field of ancient Greek astronomy, (c) because the astrological cuneiform material remained for the most part unpublished, and (d) because the corpus of standard "ephemerides", as established by Sachs and Neugebauer, was more numerous than that of the "day-to-day" ones, and it seemed thereby logical to argue that calculating the planetary phases was the central motivation of cuneiform astronomy. A belief that cuneiform astronomy was somehow a "stand-alone" discipline, with a quirky interest in planetary phases, was thus formulated. It has taken fifty years to begin to shake off this view.

Although the following suits the discussion in part B, below, on how we can determine the agendas of the ancient scholars and predict what "might have survived," it is placed here for it also highlights how powerful the agendas of the

[35] (Neugebauer 1955).

modern scholars were, when it came to the interpretion of the ephemerides. Steele argued in 2003 that the "daily motion" ephemerides would have been calculated *ad hoc* for the interval between any set of predicted planetary phases. He notes that the *manner* in which that would have been done for all five star-planets has also survived, in a set of texts we refer to now as "procedure texts". These texts were also published by Neugebauer in 1955, but it has taken until recently for us to see in them a good reason for arguing that the purpose of the ephemerides was to provide the data for personal astrology such as horoscopes. We can argue, now, that despite first appearances all the means for calculating day-to-day locations for *all* planets were present, despite there being no preserved "daily motion" ephemerides for Saturn, Mars, and Venus. I suggest, further, that given that the "daily motion" ephemerides only had a short-term relevance, they were probably considered *not worth preserving*. I would argue from this observation that this provides a good reason for why we do not now have many such ephemerides, since the modern collection of preserved astronomical texts presumably derives from an ancient collection that was repeatedly consulted and needed to be relevant for some extended period of time. That is, the small number of daily ephemerides should not be used to argue that they were not, in fact, central to the endeavour of cuneiform astronomical texts, an endeavour designed to fulfil the demands of horoscopy.

In a further example, the cuneiform lunar ephemerides calculate, amongst other things, the luni-solar intervals around conjunction, that is the time for which the moon is visible just before and just after its period of invisibility in front of the sun. Neugebauer writes of this:

> The situation at the morning of the last visibility of the moon is only the mirror image of the configuration at first visibility but without calendrical interest. To compute and to tabulate the data for the waning moon is not much more than a mathematical exercise.[36]

Here we see quoted the dual motivation Neugebauer sees as underpinning these most complex of cuneiform astronomical texts. He believed the moment of first visibility was calculated by the Mesopotamia scholars in order to determine when the month started, and he could see no reason other than academic interest for their calculating the moment of last visibility. In fact, the first and last lunar visibility intervals were ominous, and they were calculated precisely for that reason, as I proposed in 2000[37]and confirmed now by the publication, at last, of one of those late astrological texts, BM 47494.[38]

None of these data are new. They have been available for decades. Particular modern attitudes towards astrology and the motivations that lie behind the creation of the exact science of astronomy, and a certain view as to the significance of Babylonian influence on Greece and the rest of world (in

36 (Neugebauer 1975, 538).

37 (Brown 2000, 166).

38 (Hunger 2004. See line rev. 16).

pan-Babylonianism) and the reaction to that view, governed the selection of those materials to be edited, which became our corpus of cuneiform astral science texts. These attitudes however, blinded us to the likelier explanation for the production, storage, and ultimate survival of these texts, namely that they were not devised out of academic or calendrical interest, but to provide the data for horoscopes, and that a widespread interest in personal astrology was the driving force behind the spread of Babylonian astral science. Future study of the excavated and unpublished texts in our museums must start to readdress this misrepresentation, prime amongst which must be an edition of the late astrological texts.

Mathematics

The practices of ancient Mesopotamian mathematics were also significantly misrepresented by its earlier decipherers, educated as they were on the Greek classics, but the historiography is rather different to that of the astral sciences. Høyrup (1996) identifies a "heroic period" (1930–1940) of decipherment dominated by the figures of Thureau-Dangin and Neugebauer, with strengths respectively in philology and mathematics (for publications see the paper here by Proust), and characterised by an interpretation of the texts in terms of modern or pre-modern mathematical categories. The ancient compositions were treated as examples of immature modern algebra, and in some sense, therefore, as ancestral to modern mathematics. Texts were read purely for their mathematical content, and what became the corpus of "mathematical texts" in the works of Thureau-Dangin and Neugebauer was in reality a collection of the hand copies of the numerical parts of tablets gathered together in modern books.

The conclusions of the "heroic period" were then reduced still further over the next three decades or so to modern symbolic representations. It was possible, thereafter, to read a summary of the achievements of the Babylonian mathematicians, just as one could the achievements of Apollonius, say. Numbers, extracted from cuneiform tablets and transformed into decimal notation on paper, were played with by modern mathematicians, as if our way of doing maths must have been their way.

The case of the Old-Babylonian, unprovenanced tablet known as Plimpton 322 is illustrative. It "deals" with "Pythagorean triples" and was understood first by Neugebauer and Sachs in 1945 to be "the oldest preserved document in ancient number theory....," a text of "purely number theoretical character...an investigation of the fundamental laws of numbers themselves."[39]A raft of subsequent treatments ensued, all summarised by Robson 2001, for whom, Plimpton 322 cannot be understood without full reference to the tablet as an object, to other materials that are not, at first sight, mathematical, and to the

[39] (Neugebauer and Sachs 1945, 37–41).

scholarly context in which such tablets were produced. Her reinterpretation makes it hard, now, to see Plimpton 322 as ancestral to modern number theory.

Robson writes of the historiography of Mesopotamian mathematics that "since its discovery in the early twentieth century AD, (it) has been treated implicitly as part of the 'Western' tradition." There is, though, as she says, no evidence of Mesopotamian influence on classical mathematics until 150 years after Euclid, "despite a century of determined effort to show otherwise,"[40] and suggests that this effort was connected in part to a desire to bring the achievements of the ancient world within an idea of the linear development of civilisation – civilisation culminating in the cultures of Western Europe.

Said pointed up imperialistic and racist motivations behind much of the study by Europeans of the Orient in 1978, and perhaps it was a similar attitude that led to a view which appropriates cuneiform mathematics into a supposed uni-directional stream leading to Greek and European mathematics, for it implicitly disassociates that mathematics from the current cultures of the ancient Near East. Furthermore, Robson (op. cit.) rightly notes that "few Assyriologists like numbers," and this may be part of the reason why the study of cuneiform mathematics was initially handed over by the Assyriologists, with the notable exception of Thureau-Dangin, to the historians of science. This immediately distanced the mathematical material from its context amongst other cuneiform texts and artefacts from Mesopotamia and made it easier to fit its development (and aims) into a template borrowed from the study of Greek and other mathematics. Decipherment of the sources came to be thought to involve little more than the extraction of numbers, themselves treated as things of "pure magnitude" as we treat numbers today, and free to be rearranged as best suits modern reading habits.[41] It was not realised until the mid-1970s that much of profound significance was contained within the number signs themselves, and in their arrangement within the tablet.[42]

A lot remains to be done before the considerations of the latest generation of scholars filter out into the wider consciousness. These scholars are well-versed in Assyriology and treat the mathematical texts *in toto*, and not merely the numbers that can be extracted from them. They situate the earliest mathematics within the context of the burgeoning bureaucracy of the earliest city-states and within the concomitant development of writing. The pedagogical nature of the several hundred "problem texts" and thousands of "table texts" from the Old Babylonian (OB) period (ca. 1800 BCE) is stressed. It is suggested that weights and measures were learned by heart at that time, often with their sexagesimal

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[40] (Robson 2000, 95).

[41] Sachs & Neugebauer (1945) includes a chapter by Goetze on Old Babylonian dialects in an attempt to localize the source of the tablets, and their editions are exemplary, with pictures, hand-copies, transliterations and translations. Nevertheless, the material is always reduced to modern mathematical notation, and it is this that found its way into later general histories of mathematics (e.g. Cooke 1997).

[42] (Powell 1976).

equivalents, just as logograms were learned, and that the mathematical texts reflect a rote-learning methodology.[43] Høyrup insists on an idea of naïve geometry to account for what was formerly thought of as ancient number theory, connecting the processes of calculation to actual physical manipulation of objects, or of the symbols used for the numbers, and makes us question the extent to which the ancient scribes who wrote the tablets we possess conceived of number in the abstract way we do, as "pure magnitude".[44] Much continues to be controversial, but this new approach has already provided us with a very different picture of ancient cuneiform mathematics to that held up to the 1970s.

It would seem, then, that the historiography of cuneiform mathematics parallels that of cuneiform astral science, but with a delay. The first major studies appear some thirty years later than those in the astral sciences, and during the early period of that backlash to pan-Babylonianism (which I argue above runs up to the late 1980s, when it comes to the astral sciences). Perhaps surprisingly, therefore, the view up to the 1970s that cuneiform mathematics was part of a tradition which led to Greek and later mathematics does not sit well with the backlash, which minimised the apparent influence of cuneiform culture on neighbouring civilizations. It does, however, make good sense when we posit that the swing of the pendulum away from pan-Babylonianism was combined in part with an imperialist and Eurocentric agenda that assumed that if anything had been taken by the Greeks from the Ancient Near East it could only have been that which we today privilege as "proper" science, in this case mathematics with abstract numbers, or astronomy. Cumont's view on this matter, cited above, is particular clearly expressed.

Only in the last three decades or so has the study of the mathematical material in terms of categories determined from within the discipline, and not from without, been deemed to be important. The result has been to turn cuneiform mathematics into a "closed chapter" of human endeavour, for in *recontextualising* the texts that were previously read just for their "numbers", their apparent connection with the mathematics of Euclid and so forth has been severed.

By contrast, after World War I cuneiform astronomy was wrongly interpreted as a "closed chapter" by *decontextualising* it from the very material that could both account for why the astronomical texts were composed in the first place and why they spread, namely the astrological material.

A combination of factors, including the manner in which archaeology was conducted in the nineteenth century, and the way tablets, once excavated, were dealt with by museums and published by Assyriologists, and including the agendas of particular historians of science as to the impact of the Near East on their beloved Greece and what constituted the proper purpose of an exact "science", significantly misrepresented the place of both cuneiform astral

[43] (Robson 2000, 107).

[44] See now (Høyrup 2002), but his earlier work goes back to 1990.

science and mathematics in the history of science. Sensitivity to this historiography is a necessary first step in better situating both. A further, fundamental difficulty in that resituating, however, is that the sources upon which we rely to say anything at all about cuneiform mathematics and astral science are a tiny fraction of those that were produced. We need to know if those that we have are in some regard representative of what was produced, and for that we have to be extremely well informed about the cultural milieu in which cuneiform writing took place. It is to this issue that we now turn.

The Ancient Practices that Led to What Might Have Survived

A cuneiform "composition" refers here to a written work that was designated in antiquity by a title, usually the opening line. An example is the celestial divination series, known by its incipit as *Enūma Anu Ellil*, "when (the gods) Anu and Ellil..." This composition sometimes comprised 68 tablets, sometimes 70, each of about 100 lines. Most lines expressed one omen. A general structure to the composition is clearly to be discerned, irrespective of the cities or the era whence our examples come, which we call "tablets" if we are referring to the objects themselves, or "texts" if we mean what was written upon them. However, it is at this point that similarities with modern compositions end.

Few cuneiform texts can be "extracted" from the tablets upon which they were written by means of transliteration without some loss of meaning. Even a rendering into a modern cuneiform font fails to capture all the significance that might have been attached to word placement, character size, depth of incision, and so forth. The very shape of the tablet had meaning, and would have played a part in the way they were arranged in collections, for example.

Further to this, it is rare to find a cuneiform composition that exhibits "text stability", by which is meant that one particular version served as a template for the others, which were then just accurate copies. Cuneiform compositions are not, in general, the works of individuals. Some compositions are linked with individuals, but it is often not known if this refers to the owner of the particular version, the commissioner, the editor, the name of the school, the copier of the text in this case, the adapter, and so forth. Different redactions from the same site, even on the same tablet, abound, as do regional, linguistic, and scriptorial variations. While a notion of a "core composition" clearly existed, there appear to have been no notions of "unauthorised" emendations. Most compositions were freely adapted at all times, with the result still being given the same title, and sometimes still ascribed to the same "author", be that a scholar, a mystical figure from the past, a sage, or a god. When we moderns refer to the cuneiform "composition" *Enūma Anu Ellil*, say, we should understand by that something along the lines of "the set of works within the field of *Enūma Anu Ellil*-endeavour".

Cuneiform royal inscriptions narrate a form of history based on the achievements of individuals, and our modern histories adopt this practice – "Aššurbanipal invaded," and so forth, and it is a model that has been attempted for the history of mathematics or astral science in Mesopotamia. In 1923 Schnabel tried in vain to attribute the invention of the two characteristic systems of cuneiform astronomy to Kidinu and Nabû-rimmanu, largely based on references to their works in classical authors.[45] Van der Waerden[46] repeated the assertion for Nabû-rimmanu, but it is rightly dismissed by modern commentators.

As Britton[47] has shown, the textual record suggests that the process leading to the development of the most advanced lunar theory took well over a century, sometime from the 5th to 4th centuries BCE. It was the product not of individual genius, but of an institution, namely the great temples in Babylon and Uruk, and perhaps elsewhere. This explains, incidentally, why it took so long for scholars from other lands to surpass in accuracy the achievements of the Babylonian astronomers, for they enjoyed no such institutional support. It also explains why, once the institutional monopoly was lost, the script that supported it, cuneiform, rapidly fell into decline.[48] It further suggests that what lay behind cuneiform astronomical texts was not "interest for its own sake", but something practical from which the institution benefited, and I suggest that this was personal astrology, for which rich clients were prepared to pay. The tablets that have been recovered, and upon which our corpuses of astral texts are based were produced by an institution, and we should endeavour to understand them accordingly.

Nevertheless, certain groups of mathematical problem texts, or astronomical ephemerides adhere rigorously to just a few rules – indeed one set of lunar texts dating to a period covering some four hundred years can all be connected, meaning that they are all the expression of one solution as to how to model lunar behaviour. Can we assume that such rules or models derive from one "master text", composed by one individual? I believe we cannot, though it is tempting to do so, for this too fits with a commonly held view that scientific breakthroughs are made by individuals. These astronomical models, in particular, were tremendous achievements, and were used for centuries thereafter, but the little evidence we have is that they were worked on over several generations until they were perfected. If there had been a leading figure in their development, his or her name is lost, and as with most cuneiform compositions was considered to be irrelevant in antiquity. Should we attach value to an unnamed someone the ancients did not?

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[45] For references see (Neugebauer 1975, 610–12; Hunger & Pingree 1999, 214–5).
[46] (van der Waerden 1947, 281–3).
[47] (Britton 1993; 2002).
[48] As traced in (Brown 2008).

We would expect an institution to maintain archives, and also to employ archival practices such as those outlined in Clancier's article here. These might involve clearing out certain texts that are no longer in use, or copying older texts before they disintegrate. Of those texts that have survived from such institutions, we should expect many to have been written by trainee scholars, just as we should expect some of them to be standard reference works. These factors are crucial to bear in mind when we evaluate the material at hand. We are very poorly informed about the archaeological provenance of the astral texts from Babylon and Uruk, most of which date to the few centuries prior to the end of cuneiform in the first or second century CE. We are already able to make some modest suggestions as to archival practices with regard to the astronomical and astrological material, based on the content of the tablets, as shown above with regard to the planetary ephemerides, but much more needs to be done.

The situation with regard to astral omen divination is, however, infinitely better, and I propose here to draw from our understanding of that tradition some hints as to how we should delimit our corpuses of cuneiform mathematics, astronomy, and late astrology.

Astral omens appear in the Old Babylonian (OB) period near the start of the second millennium BCE, from a background heading back to the third millennium. The Neo-Assyrian period (ca. 1000–612 BCE) was witness to an abundance of astral-omen compositions, prime amongst which was the so-called *iškaru* ("the standard series") of *Enūma Anu Ellil*). Its 5,000 omens, arranged in a specific order, were concerned with the Moon, the Sun, the weather, and the planets. The *iškaru* is, in some sense, the "core composition" of celestial omina, but it was accompanied by a wide variety of complementary and spin-off texts in the Neo-Assyrian libraries whence most of our copies come. This state of affairs persisted into the period after 612 BCE. At some point prior to ca. 1000 BCE the *iškaru* was formed, in part by drawing on earlier OB material, in part by including contemporary material and inventing new during the editing process. Most Assyriologists point to the period around 1200 BCE in southern Mesopotamia as the time when this editing took place.[49] It led to a measure of textual stability, but it was certainly not the end of the editing process. It also stimulated the production of new materials referred to by Assyriologists as "commentary texts", which dealt with everything from technical aspects of grammar to questions as to the authorship of the material.

The authorship of *Enūma Anu Ellil* is attributed in turn to the gods, sages, or divine kings, and this is typical of Mesopotamian "literature" in general. Lambert writes:

> There is a Babylonian conception of canonicity which is implicit in the colophons just cited, and which is stated plainly in Berossus: that the sum of revealed knowledge was given once and for all by the antediluvian sages.[50]

[49] (E.g. Rochberg-Halton's 1984b).

[50] (Lambert 1957, 9. See further Lambert 1998).

A text from Nineveh, K 2248, attributes the composition of the celestial omen series to "the words of god Ea."[51] K 2486 + K 3646 + K 4364: 16–18 and its fragments attribute the revelation of celestial divination and some form of mathematical calculations, which are secrets of the gods, to one Enmeduranki, mythical king of Sippar.[52] Rochberg's view is that all these attributions amount to a claim for authority based on the supposed tremendous antiquity of the composition.[53] The fact that an appeal to divine authorship might also help in this, should also not be ignored.

This attribution aside, however, which we can easily explain in terms of the anticipated audience of the compositions, the reality was that the standard omen series and the commentary series were the products of editors and collators over the centuries. A brief glimpse into the process is offered by the colophon in which the master scholar of the eleventh century BCE Esagil-kīn-apli boasts of reconciling the "twisted threads" in order to produce the authorised edition of a medical omen series.[54] Rochberg connects that process to the preservation of a stream of written tradition over centuries, and like Oppenheim accounts for it in "operational" terms.[55] That is, they both argue, it comes about as a result of the way in which scribes were trained, by having them faithfully copy older material. This "pedagogical explanation" is unlikely to be the whole answer, but it is certainly part of the reason why "twisted threads" were reconciled and a "standard text" or *iškaru* produced and accounts for anachronistic linguistic forms in the later versions of the text. It also accounts for why several "schools", each using slightly different versions of the omen series can be identified in the Neo-Assyrian period.[56] Each was the product of a different group of scribes based in different cities and educating their apprentices in slightly different ways.

Part of the authority of any one *iškaru* derived, then, from its position amongst a group of compositions that were copied and recopied over the centuries. Further to that, the great omen series also enjoyed royal endorsement. The libraries and collections of the Assyrian capital city were greatly bolstered by the Assyrian conquest of Babylonia in the mid-7th century BCE, and we are well informed about Babylonian versions of the omen series finding their way there.[57] Some series formed part of a special, perhaps private royal library.[58]

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[51] (Lambert 1962, lines 1–4).

[52] (Lambert 1967; 1998).

[53] (Lambert 1967; 1998).

[54] (Finkel 1988).

[55] (Rochberg 1984b, 133).

[56] (Fincke 2001).

[57] (Parpole 1983, Brown 2000, 17–32).

[58] (Liebermann 1990).

The word *iškaru*, itself, holds a clue as to how we should interpret these "standard compositions". It is a word taken over from "assignment" as in a work assignment. The 70-odd tablet omen series were indeed assignments, commissioned in some cases for royal libraries, as the surviving colophons reveal. In other cases they would have been the personal reference tools of the master astral diviner, and the assignment of the apprentice would have been to create his own version as part of his training.

When modern scholars attempt to produce an edition of the omen series, they also attempt to pull together the threads of variant traditions, but it would be a mistake to see behind those variant traditions a "master composition" written by one individual at some particular time in the past. "Authorship" was a diffuse veil, which often helped ensure the unfalsifiability of the underpinning system by permitting contrary positions. The attribution to ancient, semi-divine or divine authors was in reality an indication of multiple-anonymous authorship. It delimited the subject matter of the series, but not its precise contents. The *iškarū* (long u is plural) were thus meant to be replete with irreconcilable prognostications, unclear intrusions, lapses of meaning – hotchpotches of syntactical and grammatical forms, all of which required some form of learned commentary, and our modern editions must also reflect this.

Thus, while cuneiform commentary texts are indeed meta-texts that presuppose the existence of another text, they are not designed merely to elucidate a fixed composition, but rather a subject area. They underpin the *iškarū*, but also address matters not in the *iškarū*.

For example, each tablet of the astral omen series *Enūma Anu Ellil* has a *mukallimtu*, listing omina with variants (*šību*) and a commentary. They are generally more learned than the *iškaru* itself, including quotes from other sources and exhibiting lexical play (punning, and so forth). This *iškaru* is also accompanied by texts described as *zâtu u šūt pî* "what goes out and from the mouth", a sort of glossary and oral commentary, made by a master scholar presumably, and added by the apprentice and copied dutifully thereafter over the centuries. Other commentary texts are:

Rikis girri, a sort of index to the series.
Ahû, an extraneous, equally authoritative series of omens, seemingly excluded in the redaction process that led to the *iškaru*.
Ša pî ummâni, meaning "the words of the scholar" omens.
Maš'altu, meaning "question" and perhaps preserves a record of the pedagogical process where the student asks the master for elucidation.
Ṣâtu, which explains old and unusual words.
Arû, numerical play on those parts of the series dealing with numbers.[59]

Each explains, elaborates on, or supplements the standard *iškaru*, without threatening its validity. I suggested that these "commentary texts" formed a

[59] See (Brown 2000, 127–9) for an explanation of their purpose.

"protective belt around the core", an expression Lakatos had used to describe the negative heuristic of the typical scientific research programme.[60] Put bluntly, the "commentary texts" of astral divination provided ample opportunity for distilling some of the principles underpinning the *iškaru* without questioning the validity of the whole discipline.

It is useful, I believe, to ask whether we might better be able to contextualise our surviving mathematical texts on the basis of what we now know of astral divination.

The Old Babylonian Mathematical Problem Texts are also products of scribal education. Text IM 67118 introduces a problem with "If (someone) asks you the diagonal," and that someone is likely the teacher. BM 13901, which lists a series of similar mathematical examples, is probably thereby expressing a general rule, a situation which exactly parallels the omen *iškaru,* which also often lists masses of parallel omens, each with just one word differing from the previous example. MCT[61] Texts G, H, and J, for example, give exhaustive possibilities on one mathematical problem.

The *mukallimtu* commentary of the omen series, however, express the rules leading to the list of parallel omens explicitly and succinctly. Might we expect, then, some mathematical texts that express a rule succinctly and explicitly, and not simply via worked examples?

Modern scholars of cuneiform mathematics stress the mechanical nature of the mathematical processes most of our surviving texts bear witness to. The so-called "Problem Texts" are geared to the available "Mathematical Tables", for example. Some problems are chosen with values found in the "Tables of Reciprocals", for example. Scribes, perhaps the run-of-the-mill type and not the master scholars, acquired their craft by learning methods by rote, and this involved learning how to use the Mathematical Tables for specific problems. The vast majority of the "mathematical" texts we possess derive in some way from institutions ("schools") undertaking this pedagogical process. It is one of the great achievements of the latest generation of modern scholars working on such material that they have been able to show the links between the various text types and to place them better within a system of "industry-standard" tablet types used by scribes in the course of their education and then employment. The commentary texts of astral divination, however, should warn us against assuming that that was all that there was, when it comes to mathematics.

The *iškarū* were the source of authority, the diviner generally a practitioner of a method handed down since time immemorial. Little premium on understanding the underlying methods can be discerned in the lists of omens, but we cannot thereby assume that it was not there. The commentary texts show that general principles were indeed understood. The textual ambiguities should also not lead us to assume that the understanding of a once pristine master text had

[60] (Brown 2000, 229).
[61] (Neugebauer & Sachs 1945).

been lost, for those ambiguities were, as argued, a necessary “protective belt.” The vast majority of the omen texts that have survived give, at first sight, the impression of a scribal discipline whose main product was a huge, sloppy and illogical omen series the practitioners used in the course of their business, without them much needing to apply their brains. But for the commentary series, it would be hard to imagine the discipline’s real intellectual depth and importance. Can we say the same about the older collection of mathematical materials? Although the vast majority appear to suggest a discipline in which mathematical methods amounted to little more than the following of simple, mechanical procedures, this impression is, too, in large part a function of what has selectively survived.

There are some hints that comprehension for some was vastly in excess of that which could be implied by the majority of surviving texts, and I suggest that we moderns must consider carefully what weight we attach to such hints in the light of what we know about other literate disciplines in Mesopotamia.

Thus, text YBC 6967 provides us with a brief, accurate example of the solution of a quadratic equation. In YBC 7289 we have a preposterously accurate value for root 2, 1.414213, expressed sexagesimally as 1;24,51,10. Perhaps most interesting of all is IM 67118: lines 1–16 where a “standard naïve-geometric procedure” is outlined for solving the following: “1,15 is the diagonal, 45 the surface, what is the length and width?” Lines 16f, however, give a correction in brute “Pythagorean” terms. Square 60, Square 45. Add, Root (i.e. 1,15 (=75) = $\surd(60^2+45^2)$ and the area = 45*60, which in sexagesimal is 45,0;0). There is even a drawing, unlabelled of a rectangle with its diagonal.

Hints, such as these, suggest to me that the degree of mathematical understanding of some Old Babylonian scholars may have been very high indeed, and that either little premium was placed on the written expression of that knowledge in the context from which our few materials come, or we are yet to find it. These hints do not express the limit of Old Babylonian understanding of mathematics, but perhaps the tip of the iceberg. They are, in this sense, not representative of the discipline, but suggest a note of caution when we moderns start to generalise about ancient cuneiform mathematics. Because they are so few and far between, by comparison with the standard tables and other tools of the trade, it is tempting to pass over them in silence, and forget that the vagaries of archaeology and/or the nature of what we do have (namely “school texts”) mean that their survival is in itself remarkable.

I draw the parallel, then, with the late astral material, discussed above, for despite their small number, it is the horoscopes, the few procedure texts, day-to-day ephemerides, and late astrological texts, which hold the clue as to the real purpose and capabilities of the cuneiform astronomy we have represented by many hundreds of standard ephemerides, Diaries, Almanacs, and Goal Year texts. The still more numerous texts of astral divination have shown that alongside the “tool-of-the-trade” omen series were an array of spin-off, or complementary compositions attesting to far higher levels of abstraction, literary play, and theorising on the subject at hand. Using this as a model should encourage

us to look again at material seemingly peripheral to our main collections of mathematical and astronomical texts, and by bringing them into the respective corpuses, see if we thereby might hit upon some new insights as to the true significance of the disciplines within Mesopotamian culture, with ramifications, perhaps, for the general history of science.

Conclusion

Our improving understanding of the practices of cuneiform scribes and scholars, the ways in which they acquired the skills of writing and the materials they used to this end, and in the course of their professional lives, shows us that it is a mistake to assume that what has survived is representative of what was produced. We possess far too small a proportion of what was written to suggest that we have a "fair sample". The unusual situation that led to the recovery of substantial parts of the state and personal archives and libraries of the Assyrian capitals reveal that in the case of celestial divination the array of relevant texts is very wide indeed, and suggests that the same may have been true for the mathematical, astronomical and later astrological materials. I have argued, for example, that the vast majority of cuneiform texts written on astral science in the script's last six centuries were done so in the service of personal astrology, despite the contents of our surviving corpus of astral material seemingly pointing to an interest in prediction for its own sake, or with the aim of regulating the lunar calendar.[62]

Excavations in Babylon and Uruk, be they illicit or legal, concentrated on uncovering institutions and not private dwellings, and primitive museum practices of buying only large tablets, resulted in the current corpus being the way it is. It was, however, also a particular view of how science develops and an attitude towards astrology and a backlash to a movement that had sought to use that astrology to support a pan-Babylonianist ideology, that prevented us from seeing far earlier the true importance of that astrology for the concomitant astronomy on the basis of the few surviving hints that did make it into the corpus.

I have drawn a few parallels with the far older mathematical materials, whose treatment, it was argued above, was also affected by particular agendas circulating amongst twentieth century scholars. A reaction to that by Assyriologists who have worked with these materials since the 1970s, has rightly aimed to situate them within a Mesopotamia context, and to sever their relevance to any unidirectional account of the development of mathematics towards European

[62] Most surviving cuneiform texts of Hellenistic date or later are astronomical or astrological in some way. This fact alone indicates the importance of the discipline in the survival of cuneiform so long after the land ceased to be ruled by speakers of a language commonly written in cuneiform. The largest group comprises the astronomical data records, followed by the standard ephemerides.

supremacy, as if that were the only reason to study these materials in the first place. The mechanical processes of calculation that led, for the most part, to the texts we have, have been reconstructed and the assumption that an abstract concept of number was employed has been disputed. Nevertheless, those few parallels with the astral divination materials suggest to me that the hints we have of an abstract mathematics lying behind the "Problem Texts" may need to be given more weight.

Lastly, I argued that we should not seek to produce a "master composition" of cuneiform mathematics or astral science from what has survived by adopting a methodology better suited to the modern situation. Rather we should understand the literate situation in Mesopotamia as being one less concerned with an authoritative composition as with an authoritative "field" of intellectual activity. This field is one to which any author could contribute and in which no one author was regarded as special, except where that author was in some way supernatural and whose name thereby vindicated the validity of the whole discipline. Each authorial contribution could, theoretically, become a part of what was then copied over the generations. Modern editions should reflect this gradual accretion, and not seek a time when the pristine composition came into being. Furthermore, no one composition of the field should be used to assess the level of Mesopotamian achievement in that same field, but rather all that we have and all that we have good reason to suppose we might one day have.

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Knowledge and Practice of Mathematics in Late Ming Daily life Encyclopedias

Andrea Bréard

Since the Song dynasty the official bibliographic monographs referenced an independent category of works generally translated as "encyclopedias" (*leishu* 類書, lit. "books topically arranged"), a classification developed by the Confucianist Zheng Qiao 鄭樵 (1104–1162).[1] The *leishu* sections included a heterogeneous range of collections of examination literature, biographical dictionaries, primers in how to read classical literature, handbooks on the art of letter writing, pharmacopoeias, geographical surveys, administrative and procedural manuals, and the like.[2] Although the first work officially considered as a *leishu* in this category was compiled during the third century under official auspices,[3] it was only during the Song dynasty that the widespread use of printing facilitated the task of compiling such topically arranged compilations of books or excerpts from a number of sources.

It was then that also more general encyclopedias destined for daily reference began to appear, but they first remained for use of the literati and their needs to prepare for the imperial examinations. With the economic boom under the Ming (1368–1644) that allowed higher social mobility, the spread of literacy, and the

I am particularly grateful to Kathryn Lowry for generously sharing her knowledge about these sources.

[1] For an introduction to Song dynasty encyclopediasts and their commitment to being comprehensive, scholarship, and the preservation of cultural values see (Tillman 1990–92).

[2] On the scope of *leishu* see (Hu 1982, 1–14). Kaderas (1998b: chap. 4) describes all the sixty-five *leishu*-"encyclopedias" which are included in the imperially commissioned text collection *Siku quanshu* 四庫全書 compiled between 1772 and 1780. For early Song dynasty encyclopedias and anthologies see (Kurz 2003).

[3] *Huanglan* 皇覽 (Works for Imperial Reading) compiled by Miao Bu 繆卜 and others at the command of Cao Pi 曹丕 (Emperor Wen of the Wei 魏文帝, r. 220–226) in 120 *juan*. The work was lost after the Tang dynasty (618–907).

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F. Bretelle-Establet (ed.), *Looking at It from Asia: The Processes that Shaped the Sources of History of Science*, Boston Studies in the Philosophy of Science 265,
DOI 10.1007/978-90-481-3676-6_10,

production of paper and books at a lower cost, a new encyclopedic genre emerged at the end of the sixteenth century and developed all the way into the early twentieth century when the last editions were printed. These daily-life encyclopedias, in which the kinds of knowledge traditionally reserved for the upper class were presented in a distinctly different way—explicitly by their title and also by their enlarged content beyond orthodox Confucian learning—began to address a wider reading public that did not necessarily have examination degrees. The editors' imaginary audiences were the "four folks" (*simin* 四民)—scholars (*shi* 士), farmers (*nong* 農), artisans (*gong* 工), and merchants (*shang* 商)—and showed a female presence with assumed interests in their publications.[4] The editors' intentions and imaginary audiences would have little meaning if there was no match with encyclopedia buyers and readers. Unfortunately we know little about the actual reading public so far. But if the aim of these encyclopedias is the diffusion of knowledge, the book-buying power of less than a daily wage is an important measure. The frontispiece of the *Complete Book of Five Chariots of a Myriad Treasures* (*Wuche wanbao quanshu* 五車萬寶全書, 1614 ed.), for example, indicates a price of one ounce of silver (one *liang* 兩) per book. The monthly wage of a farmer or an oil presser in Zhejiang province in 1580 was of 18 or 240 *liang* respectively.[5] Although we have no precise data on the number of copies and editions sold (and actually read), scholars have conjectured that these late Ming imprints have largely circulated beyond the Jianyang county market in Northern Fujian province, where they primarily were edited and printed by commercial publishers.[6]

Looking at the different book titles that vary from one chapter to another, it is obvious that for their compilations the Jianyang printers participated in a process of recycling readily available print material. Entire woodblocks went from one Jianyang printer family to another,[7] carved in a distinct and stable textual layout: blocks of seemingly unrelated texts were printed in two or

[4] For a discussion of the idealized reading public of "daily use" encyclopedias, see (Lowry 2005, 100–104).

[5] See (Kang 1986, 218). See (Rawski 1985) and (Rawski 1979) on the question of literacy during the late imperial era.

[6] Besides Jianyang, Nanjing was one of the two largest book centers in China. Chia (2002, 135) nevertheless underlines the absence of daily life encyclopedias published by Nanjing commercial publishers. Although she assumes that there were buyers "it may be that the need was supplied from Jianyang and other printing centers, or even by printers in and around Nanjing of whom we know nothing, not even their names."

[7] The 1614 edition of the *Wanyong zhengzong bu qiu ren* 萬用正宗不求人 (complete title: *Jianqin Chongwenge huizuan shimin wanyong zhengzong bu qiu ren quanbian* 鼎鋟崇文閣彙纂士民萬用正宗不求人全編) for example reproduces chapters from the following titles of other late Ming daily-life encyclopedias:

- 類聚三台萬用正宗
- 鼎鋟崇文閣彙纂四民捷用分類萬用正宗
- 鼎鋟崇文閣彙纂四民捷用分類學府全編
- 學府全編

even three separate horizontal sections[8] per page, one above the other, for the reader to choose. Thus in a chapter entitled “Traveling Merchants” (*Shanglü* 商旅) the rubric “Warning Instructions for the Traveling Merchants” “offers tips on coping with strangers, establishing temporary relationships with fellow travelers, and protecting oneself from against robbery and fraud . . . The upper register of the page contains “Norms in Brothels”. . ., which consists of separate discourses on whoremongering cast in the form of conduct books.”[9]

Although the popularity of the daily-life encyclopedias spread all through the early twentieth century and into Japan, only few of these compilations were preserved in Chinese libraries, not to speak of the dynastic bibliographies and imperial collections in which they are not included. Printed on cheap paper, abounding in typos, using the popular or simplified form of Chinese characters, and containing secret knowledge[10] and knowledge outside the realms of canonical literature, several scholars of their time had expressed a negative attitude towards these encyclopedias. They accused them of being distorted[11] and “irregular” (*bu zheng* 不正) in terms of Confucian orthodoxy.[12] It was only at the beginning of the twentieth century that neglected documents of this type were rediscovered and used as sources; historians of China from diverse fields have become increasingly interested in them during the last decade.

Since then, contemporary Chinese, Japanese and English language studies use the terms *Riyong leishu* 日用類書 or *Riyong baike quanshu* 日用百科全書 (lit. encyclopedia for daily use) to delimitate the literary genre. Although we can find many Song, Yuan, and Ming dynasty books referring to “daily use” in their title,[13] it should be stressed that the term “encyclopedia for daily use” does not correspond to an expression used to refer to these compilations or to a historical reality in early modern biographical classification schemes. Looking at Ming dynasty book catalogues I only found a reference to one of the first daily-life encyclopedias from Song dynasty and forerunner of those published in the Ming. The *Extensive Records of a Forest of Matters* (*Shilin guangji* 事林廣記, 1066), compiled by a native of the Northern Fujian area, is mentioned in

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8 This layout can be seen for the first time in the *Qi zha qing qian* 啓箚青錢 (first printed in 1436).

9 See (Shang 2005, 69–70). Shang concludes that “the inclusion of these texts in daily-life encyclopedias shows that visiting brothels was recognized as part of the experience of the traveling merchant’s life.”

10 See (Brook 1998, 167–171) on the illegal contents in popular encyclopedias, such as the interpretation of celestial phenomena as omens.

11 See for example [Ming] Lu Bi’s 【明】 盧璧 preface (p. 1b) *Kaozheng zhupu dalüe* 考證諸譜大略 (“Survey of all treatises [on chrysanthemum]”) to the *Dongli pin huilu* 東籬品匯錄 (2 *juan*), where he complains that he had not seen any complete text of a Song dynasty treatise (*pulu* 譜錄) on chrysanthemum, but only versions abbreviated arbitrarily (*renyi* 任意) by authors of encyclopedias (*leishu*) like the *Comprehensive Records of a Forest of Matters* 事林廣記 and two others. I am much indebted to Martina Siebert for this reference. See (Siebert 2006, 268–9; 281).

12 *Baoding fuzhi* (Gazetteer of Baoding prefecture, 1607), 40.26b.

13 In mathematics for example there are Yang Hui’s *Mathematical Methods for Daily Use* (*Riyong suanfa* 日用算法, 1262). See (Lam 1977), (Li [1954] 1998, 6:448–455).

a bibliography which served as a basis for the compilation of the official "Monograph on Bibliography" chapter in the *Ming History* (*Mingshi Yiwenzhi* 明史藝文志), but the suggestion of the compiler Huang Yuji 黄虞稷 to include the *Extensive Records of a Forest of Matters* in the final version was not retained.[14]

In the following discussion I will focus on two articles from late Ming daily-life compendia: the "Chapter on mathematical methods" (*suanfa men* 算法門) and the section on the game of "ivory tiles" (*yapai* 牙牌) included in a "Chapter of the eight treatises" (*Ba pu men* 八譜門). Both deal with what one might characterize as mathematical knowledge and practice in distinct social contexts. My analysis is based on six Jianyang editions of daily-life encyclopedias from the early seventeenth century, a late sixteenth century Jianyang imprint devoted solely to mathematics, and the most widely known and printed late Ming mathematical book, published in the Anhui province, Cheng Dawei's *Unified Lineage of Mathematical Methods* (*Suanfa tongzong* 算法統宗, 1592). I will refer to the six studied encyclopedias for daily use as the *Complete Books of A Myriad Treasures*, since they all carry reference to their completeness (*quan shu* 全書) and/or ten thousand precious uses (*wan bao* 萬寶 or *wan yong* 萬用) in their complete titles.

In a first section, I shall review what has been said by historians of science in China about Ming dynasty non-elite "popular mathematics" (*minjian shuxue* 民間數學) and what recent interest Japanese and other scholars have had in Ming dynasty encyclopedias for daily use. I will then analyze the social and historiographic reasons why these books have not been preserved or valued at the time, in spite of their important role in making knowledge accessible. Such lack of transmission and appreciation can be linked to the fact that today's historians of mathematics are not aware of these sources. Taking the daily-life encyclopedias' mathematical sections into account will shed new light on the textual origins of other early modern mathematical writings and the circulation of mathematical knowledge between diverse social groups. They allow studying more general questions about the relation between textual transmission and knowledge selection and organization in encyclopedic writings. Finally I shall argue that these encyclopedias significantly enrich the picture of mathematical praxis. They not only reveal the diversity of calculatory and educational practices during Ming dynasty, but they also raise new questions about the link between gaming and combinatorial practices.

Complete Books of a Myriad Treasures—a "Popular" Genre?

Contemporary historical writing on mathematics in early modern China usually draws a clear distinction between the classical, scholarly and exegetic tradition related to the Han dynasty canonical book, the *Nine Chapters on*

[14] See the Song dynasty additions to the *leishu* category in *juan* 15 of Huang's *Qianqingtang shumu* 千頃堂書目 (Huang 2001). I am grateful to Martina Siebert for providing me this information.

Mathematical Procedures (*Jiu zhang suan shu* 九章算術)[15] and "popular" mathematics. By the latter, authors refer to texts on arithmetical methods and abacus calculations, characterized as of little originality and representative of the decline of mathematics during the Ming.[16] The historian of mathematics Li Yan (1892–1963) took these sources labeled as "popular" more seriously, and published an entire book on thirteenth and fourteenth century "popular mathematics" (*minjian shuxue* 民間數學). Not only does he try to give a complete picture of the content and fate of the sources that have survived, but he also expresses his regret, that so many have not been preserved.[17]

Yet, this dichotomy between an elite and a non-elite mathematical tradition recently constructed by historians of science is not historically ungrounded. Of a Yuan dynasty arithmetic book it is said in the late sixteenth century that "because it contains multiplication and division [methods] but nothing from the *Nine Chapters*, it is incomplete/imperfect (*you cheng chu er wu jiu zhang bu bei* 有乘除而無九章不備)."[18] Prefaces and the structure of some mathematical writings of the Yuan and Ming equally attest the idea of a "high" tradition, associated with the *Nine Chapters* and its subsequent commentaries and extensions, and distinctly "low" arithmetical traditions that coexisted in parallel. Ding Ju, for example, in the preface to his *Mathematical Methods* (*Ding Ju suanfa* 丁巨算法, 1355) states:

> From the Tang to the Song dynasties, there were specialized fields, but from then on the prevailing fashion was unreliable, high-sounding talk and general outlines without reckoning names and objects. Those who participated in this were only sub-official functionaries. Because of the imperial examination system, the literati could not devote themselves to mathematics. Only I, since my young age, did not follow these tendencies. During the time remaining after the study of ancient literature, I tasted the methods of affairs and the measurement of things (*shifa wudu* 事法物度), and particularly applied my mind to the study of mathematical procedures (*suan shu* 算術) of one hundred schools: from the top of the *Nine Chapters* down to the bottom of the "minor methods" (*xiao fa* 小法). I extracted the essential mathematical methods and briefly described them in eight books, denominating the ancient methods with common expressions.[19]

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[15] Translated, edited, and annotated in (Chemla & Guo 2004). See also K. Chemla's article in this volume on historiographic issues related to the *Nine Chapters*.

[16] See for example (Martzloff 1997, 159) or (Yabuuti 2000, 110):

> L'essor des mathématiques populaires: [. . .] sous les Song du Sud où le commerce était florissant, des ouvrages dont la matière se rapportait au commerce et à l'artisanat furent publiés. Leur contenu, rarement original, n'était pas d'un niveau très élevé, mais il satisfaisait la demande populaire.

[17] (Li 1957, 2:410). See also (Li 2001).

[18] See (Cheng 1990, *juan* 17 算法源流) on (He & An 1993). All 3 extant 1373 editions of (He & An 1993) are now in Japan. See (Li [1957] 1998, 2:479).

[19] Preface to *Ding Ju suanfa* in (Ding & Bao 1872). p. 1b. Edited and punctuated in (Li [1957] 1998, 2:420–21).

Unfortunately only fragments of Ding Ju's book have survived and so far we cannot reconstruct its original structure. All we can say is that it contained both: problems from the *Nine Chapters* and detailed descriptions of elementary arithmetical techniques.[20] Concerning Wang Wensu's 王文素 *Mathematical mirror of old and new mathematical learning, newly collected and thoroughly edited* (*Xinji tongzheng gujin suanxue baojian* 新集通証古今算學寶鑑, preface dated 1524), the only extant manuscript copy has transmitted the first fourty-one scrolls, but not the last section of three scrolls entirely devoted to mathematical poems (*shici* 詩詞).[21] Judging from the *Complete Books* and other Yuan and Ming dynasty mathematical writings, these were formulated for pedagogical purposes in pithy rhymes with vernacular expressions, and could easily be committed to memory for ready use. It is hard to draw any conclusion from the loss of one literary type of mathematical source that is likely to stem from oral and thus less valued traditions than the received written sources with a more stable identity. But there is another book from Ming dynasty, entirely preserved in many subsequent editions and reprints, whose topical organization reflects the divide between noble and minor mathematical and textual traditions. In Cheng Dawei's *Unified Lineage of Mathematical Methods* (1592), after two introductory chapters on the legendary origins of numbers, explanations of technical terms, weights, measures, and basic definitions and rules for abacus calculations, the core of the book follows strictly the chapter division of the *Nine Chapters*—or at least what Cheng then thought to be in the *Nine Chapters* since it seems that he had not seen an original complete version of the canon. The last five chapters of the *Unified Lineage* are entitled "difficult problems" and probably go back to a Yuan dynasty author, who equally appended them to another mathematical book, which according to its title was an explanation of the *Nine Chapters*. What is interesting to note is that within these five chapters the first four give these "difficult problems" again classified according to the *Nine Chapters'* taxonomy and in the very last chapter Cheng appends all the "miscellaneous methods" (*zafa*) that do not correspond to any category found in the *Nine Chapters*.[22] Cheng Dawei exposes this classification explicitly in the preface to the "Difficult problems":

> Concerning the difficult problems: from 1404 on the Honorable Liu Shilong 劉仕隆 from Linjiang [in the province of Jilin in Northeast China] together with all the Noblemen of the Grand Secretariat prepared and collated the *Great Compendium* [of *Yongle* reign]. When he retired from his official duties, he compiled the 'difficult

[20] For an analysis of the *Ding Ju suanfa* see (Friedsam 1997).

[21] See the Table of contents in (Wang 1993, 345–347). It is interesting to note that these versified problems are classified following the tunes according to which they were to be recited, as for example: *Shuixian zi* 水仙子 (The Immortal watching over the river), *Xijiang yue* 西江月 (Moon of the Western River), *Luomei feng* 落梅風 (Wind from falling plums), *Shanpo yang* 山坡羊 (Lamb on a Precipice), *et al.* A single tune may have many variant forms both in terms of basic structure, line lengths, rhymes and intonation and mood.

[22] See the table of contents at the beginning of *juan* 13 in (Cheng 1990, 800–803).

> problems' and appended them to the *Perspicuous mathematical methods from the Nine Chapters* (*Jiu zhang tongming suanfa* 九章通明算法).[23] Also, in the *Analogical categories to the Nine Chapters* (*Jiuzhang bilei* 九章比類) by Wu Xinmin[24] from Qiantang and in the *Mathematical methods from all schools* (*Zhujia suanfa* 諸家算法), the collected poems, verses, and slogans/verbal instructions (*shici gekuo kouhao* 詩詞歌括口號) are named 'difficult problems'. 'Difficult' means difficult (*nan zhe nan ye* 難者難也). But they only seem difficult, and in reality they are not difficult. It's only their wording that is tricky. Once exposed by a mathematical master, one realizes that it is not true that nobody knows how to manipulate/arrange them, and that all the difficult methods that one does not know do not go beyond the *Nine Chapters*. The 'difficult problems' outside the *Nine Chapters* only consist in establishing the method. . . . Now, we list separately the explanations and discussions of the solution methods according to the *Nine Chapters*, and append a collection of miscellaneous methods at the end of the *Unified Lineage*.[25]

The "miscellaneous methods" and the content of the two introductory chapters of the *Unified lineage* are more or less the problems, methods, and song-lyrics that one can find in the mathematical sections of the six early seventeenth-century *Complete Books of a Myriad Treasures* that I have discussed. Not unlike the *Complete Books* of the late Ming, the *Unified Lineage* participates in the very process of representing and reorganizing contemporary commercial print materials.[26]

I will come back to this in more detail in the second part of the paper, for the moment let us retain that certain documents that are generally acknowledged by today's historians to be of "popular" type, are in fact not entirely independent of the mathematical elite tradition. This point is evident for the historical construction of the mathematical knowledge contained within these sources. The methods and problems, which we can find in "popular" writings, were nourished by mathematical activities described in the canonical *Nine Chapters*.[27] But in times of commercial printing[28] we can also look at this

[23] According to Cheng Dawei's survey of mathematical literature of his time (*Suanfa yuanliu* 算法源流 in *juan* 17 of the *Suanfa tongzong*), the *Perspicuous mathematical methods in the Nine Chapters* was compiled by Liu Shilong in 1426.

[24] Literary name of Wu Jing 吳敬 (fl. 1450). The Complete title of his book is: *Jiu zhang suanfa bilei daquan* 九章算法比類大全 (*Great Compendium of analogical categories to the Nine Chapters of Mathematical Methods*).

[25] See (Cheng 1990, 799).

[26] On the possible different sources of the *Unified Lineage* see (Guo Shirong 1993). Cheng Dawei compiled several years later an even more concise handbook for abacus calculation, but it was less successful.

[27] In (*Santai wanyong* 22:15b–16a) for example one finds a rhyme and two problems concerning the summation of finite series. I have shown (Bréard 1999) how this type of problem and the solution procedures have evolved out of the calculation of continuous volumes and in particular considerations of piles of grains in chap. 5 of the *Nine Chapters*.

[28] This term refers to such imprints that were meant to be sold on the open market, in contrast with official and private, "family" or literati publishers. Colophons, self-advertising strategies used in the title and internal characteristics of the text (punctuation, types of illustrations, etc.), show fairly clearly for what range of readers publishers were producing, but the term remains nevertheless ambiguous. See (Brokaw & Chow 2005, chap. 1).

connection of popular and elite culture from an editorial point of view, since content definitions might well have been related to an editorial intention. By including knowledge from different traditions the books could indeed reach a wider audience and thus sell better.

Cheng Dawei's book certainly did sell very well, it even influenced mathematics in Japan and it was one of the few Chinese mathematical books in the French Royal library, which held three copies.[29] But what about the others that have not even survived, or most of the *Complete Books of a Myriad Treasures* that are now preserved mainly in Japan?

They presumably were not preserved because for several reasons they were not considered worthy of conservation, the cheap paper they were printed on perished quickly, or their content had become obsolete. Since the wider spread of print material during the Song, scholars complained about the abundance and growing facility to access books. The philosopher Zhu Xi (1130–1200) for example complained about the consequent change in the way books were read:

> The reason why people today read books in careless and superficial fashion is because there are so many printed volumes. . . . Because people of old lacked books, they could only acquire them by memorizing them from beginning to end.[30]

When commercial publishing later flourished in Northern Fujian, the notorious Ming dynasty bibliophile Xie Zhaozhe 謝肇淛 (1567–1624) observed with regret the bad quality of Jianyang imprints:

> The bookstores of Jianyang put out the largest numbers of books, but the printing and paper are wretched, because they are meant to make money and not to be transmitted through the ages. In general, books printed for the purpose of making profit cannot be well produced, so they are not worth the cost of their printing [lit. throwing away twice the cost of the book (by buying it)]. . . Moreover, the woodblocks are thin and brittle and liable to crack after a while, so that the characters lose their true form. This is the case of problems with books from Fujian.[31]

The validity of certain sections in the *Complete Books* was certainly also limited in time, as is the case for the calendar section, descriptions of merchant routes or problems of commercial mathematics involving exchange rates that had become outdated.[32] Looking at the different editions of the *Complete Books* from late Ming until the late Qing, one can also observe a shift from an editorial intention of completeness, providing background information and theoretical considerations towards simpler, more practical solutions to problems in everyday life, and the dropout of fields that became too specialized and started to

[29] (Biot 1839) and (Landry-Deron 2004).

[30] Cited from (Chia 2002, 375).

[31] (Xie 2001, 13.21a–22a). Translated in (Chia 2002, 185).

[32] Wu Huifang (2000, 109) makes the general hypothesis that these books were discarded after use because their content was no longer adapted to the necessities of the time.

have a separate literature (e.g. economy, agriculture).[33] Sakai (1958, 62–74) found that over time this change of content showed a tendency of the Jianyang publishers to cater more material useful to the non-elite and the new commercial elite, and no longer to a wide range of society including the scholarly elite which was the social group more inclined to collect books or provide the authorities with printing material to be included in imperially commissioned collections.

Another aspect that might have upset the higher social classes that so far had privileged access to certain kinds of knowledge was secrecy. Although the topics and chapter headings at the very beginning of the *Complete Books* always reflect the classical trilogy of heaven (*tian* 天), earth (*di* 地) and man (*ren* 人): "Celestial patterns" (*Tianwen* 天文), "Historical geography" (*Diyu* 地輿) and "Biographies" (*Renji* 人紀),[34] we will not find what is under that same heading in the official dynastic histories. The latter section is about dynastic lineages, giving the ministers, generals and Emperors of each dynasty as well as the duration of their respective reigns. When we look at the content of the *Celestial patterns* section for example, instead of astronomical knowledge[35] we find techniques of foretelling the future and interpretation of celestial phenomena as omens. This was restricted knowledge, for only the emperor was permitted to divine heaven's will. Brook (1998: 167) interprets such "illegal" inclusions of omens which "presumably circulated as secret lore among the people" in the light of commercial publishing. The editor being "an entrepreneur willing to make information of any provenance available for a price without concern for legal consequences" responds with his omens to common anxieties, such as vulnerability to price fluctuations. Another example of secret knowledge included in the *Complete Books* is the description of rules and odds for games of chance, and mathematical procedures explicitly presented as "secretly transmitted" (*mizhuan* 秘傳) methods.

The 1772 imperial edict concerning the criteria of collection, inclusion and exclusion of books and manuscripts in the Qianlong Emperor's (r. 1736–1796) encyclopedic project to compile a *Complete Library of the Four Treasuries* (*Siku quanshu* 四庫全書)[36] clearly states that books like the daily-life encyclopedias were considered useless for his purpose:

> We thus command the provincial governors, commissioners of education and others to generally order their subordinates to apply their mind particularly to the acquisition

[33] Wu Huifang (2001, 100–114), who has analyzed 20 editions printed between 1597 and 1906 also underlines the reduction of volume from 30 or 32 scrolls for the early 17th-century editions to exactly 20 scrolls in the mid-Qing.

[34] In the earliest model of a daily-life encyclopedia, the *Comprehensive Records of a Forest of Matters* (*Shilin guangji* 事林廣記, 1266) we can find the same sequence, although each of the three topics is treated in two subsequent chapters.

[35] See for example the official History of Yuan dynasty (*Yuanshi* 元史), *juan* 48 & 49, *Astronomical Treatise* (*Tianwen zhi* 天文志) on astronomical observations and instruments.

[36] On this compilation project see (Guy, 1987).

> and search [of books]. Discarded should be what is sold in the commercial bookstores, like essays written for state examinations and the useless popular (*minjian* 民間) genealogies, letter guides, greeting scrolls, and the like. Furthermore do not merit to be selected all those by authors who basically possess no knowledge of "practical learning" (*shixue* 實學)[37], who merely hunt for fame, and who only to please others assemble trifling and inappropriate excerpts from drinking and singing prose and lyrics.[38]

A reading of this edict as the cultural self-understanding and the cultural politics of a Chinese monarch explains partly that encyclopedic books reflecting the entire repository of daily-life were of no cultural value to the scholarly elite. It is furthermore known that Qianlong's compilation of the *Siku quanshu* served also some of the functions of a literary inquisition, and that almost 2,500 works mostly by Ming authors were suppressed, in particular "volumes of geography or travel containing information considered harmful to China's defenses."[39]

After having made several hypotheses why daily-life encyclopedias might have had a low survival-rate during the Ming and Qing, let me summarize the interest recent scholarship has had for these texts and recall the history that allowed their rediscovery and reintegration into studied corpuses. Already before the 1930s, Niido Noboru 仁井田陞 started to collect daily-life encyclopedias in China. He used them for his research on legal history, and donated his collection to the Institute of Oriental Culture at Tokyo University (*Tōkyō daigaku tōyō bunka kenkyûjo* 東京大學東洋文化研究所). But during the Second World War, all but the Ming dynasty editions were destroyed in the bombings, which explains Japanese scholars focused interest in *Complete Books* from that particular period of time.[40] They studied aspects of the history of popular education, medicine, literature or commerce, treating these cheap imprints as direct reflections of social or economic realities.[41] Chinese scholars' interest in the *Complete Books* mainly focusing on trade routes arose in the 1980s.[42] Recently, due to some Japanese scholars' effort to reprint a series of late-Ming daily-life encyclopedias,[43] some historians of literature, book culture, and art studied them in a new light, as a category of cultural products that played

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[37] An intellectual movement with statecraft and scientific knowledge at its center. See (Bai Limin 1995) for the early and mid-Qing when mathematics was regarded as its foundation.

[38] A German translation and the Chinese text of the edict is given in (Kaderas 1998a), here p. 354 and 358–9.

[39] See (Spence 1990, 101). See also Chu Pingyi's contribution in this volume on the processes that led to the composition of the section on mathematics and astronomy in the *Siku quanshu*.

[40] (Wu Huifang 2000, 110).

[41] E.g. Sakai Tadao 酒井忠夫, Sakade Yoshinobu 坂出祥伸 and Ogawa Yoichi 小川陽. Honda Seiichi (1995) studied the mathematical section of the *Santai wanyong zhengzong* in relation to contemporary commercial manuals. Sakai (1970) insists on the educational role of the *Complete Books*.

[42] For detailed references see (Wu Huifang 2000, 117).

[43] See my bibliography, section 1. *Jianyang Imprints* for the detailed titles reprinted in the series *Chugoku nichiyō ruisho shusei* 中國日用類書集成 (Collection of Chinese encyclopedias for everyday use).

an important role in the prosperous print culture and cultural consumption of late-Ming China.[44] But in the historiography of mathematics these sources have never been studied for the mathematical knowledge they promoted and for the social practices related to mathematics that they reveal.[45]

It seems an irony of history, that one late Ming mathematical book little valued by modern historians of science nevertheless was most influential on early Western writings about China. It was not the *Nine Chapters* but the widely circulated already mentioned compilation by Cheng Dawei, the *Unified lineage of Mathematical Methods* (1592) that reached Paris through the Jesuits in the late seventeenth century. It was used as a basis for entries on numbers, weights and measures in Rémusat's Chinese grammar (*Élémens de la grammaire chinoise*, 1822) and Morrison's *Dictionary of the Chinese language* (1815–1823) and presented in the *Journal Asiatique* in 1839.[46]

In the next section, I will give a more detailed picture of the structure and content of the *Complete Books* I have studied and in particular confront their mathematical sections to two contemporary books devoted entirely to mathematics. This will reveal the importance of the inclusion of the *Complete Books* in the corpus of the history of mathematics in early modern China.

Popular/Local Knowledge Versus Literati/Universal Knowledge

I will limit my analysis here to two sections that relate to mathematics in a distinctly different way and that can be found in all the *Complete Books* that I have studied: (1) "sections on mathematical methods" (*suanfa men* 算法門) describing problem solution procedures and rhymes for calculations mainly with the abacus and (2) descriptions of the game of "ivory tiles" (*yapai* 牙牌), that bear witness of a practice of mathematical chance.[47] What is striking is that

[44] Lucille Chia (2002) studied in great detail the cultural history of books produced by the commercial publishers of Jianyang, Fujian (11th to 17th centuries). Wang Zhenghua (2003) focuses on the sections on calligraphy and painting to examine how the household encyclopedia helped to delineate a social space different from the literati circles. Shang (2005) shows how the novel *Jin Ping Mei Cihua* (*The plum in the golden vase*, preface dated 1617 or 1618) turns itself into a sort of encyclopedia by incorporating into its narrative a repository of reference equivalent to that in the *Complete Books*.

[45] Yabuuti (2000, 119–121) merely underlines the interest of popular sources for economic and social history: "Outre des problèmes traditionnels, les ouvrages de mathématiques populaires traitent aussi de questions liées à la vie urbaine ; ils constituent donc des sources très utiles sur l'économie et la société."

[46] See (Biot mars 1839, 202). Biot mentioned it even earlier in a note in the *Journal des savants,* 1835. On Chinese mathematics Biot then only could consult the *Zhoubi suanfa*, the *Suanfa tongzong* and one mathematical work from the Tang dynasty.

[47] Such retrospective reading of sections on games of chance as mathematical chapters is due to my probabilistic analysis of the domino game. The winning schemes must have been designed with the help of combinatorial calculations and not simply by experiment or frequent repetition and recording of results. See (Bréard forthcoming a).

Table 1 Selected mathematical content of various Ming dynasty texts

	盤珠算法 (1573)	五車拔錦 (1597)	三台萬用正宗 (1599)	文林聚寶萬卷星羅 (1600)	萬用正宗不求人 (1609)	萬書淵海 (1610)	五車萬寶全書 (1614)	算法統宗 *juan 17*(1592)
Front illustration	Untitled: student with abacus and a teacher		禮樂射御書數 The "Six Arts" (taught by women)			算法門 Teacher with abacus and student	隸首真傳 The model of tradition by Li Shou[48]	師生問難 The teacher's students inquiring about the difficult
Title of upper section	-	算法捷徑	書算通玄	算法捷徑	精採算法真訣	算法捷徑	要紗源流	no such layout
Title of lower section	隸首上訣	算法式要	算法門	算法式要	算法門類	算法門	–	
算盤定式 Shape of the abacus (illustrated)[49]	illustrations of diverse number configurations	*		*	*	*	*	(*)
算法源流 Origins of mathematical methods			*[50]					

[48] The person who was regarded as the mathematical scholar of the time when the exploration of the skies began was the mythical Yellow Emperor's (27th century B.C.) minister Li Shou. Considered a legend among the Chinese people, he is said to have been in charge of creating arithmetic (Yan & Du 1987, 1–2).

[49] Illustration of an abacus as already found in the *Guide to Mathematical Methods (Zhiming suanfa* 指明算法, 1439). Yabuuti (2000, 113) gives a picture of this illustration.

[50] The *Nine Chapter's* chapter headings, for example, are explained with citations which we can find as early as in a commentary by Liu Hui (263). More detailed explanations in general terms and in relation to government administration are added here. The text is identical to the one given in the *Comprehensive Record of a Forest of Affairs (Shilin guangji* 事林廣記, 1266) 中集上卷. See a transcription thereof in (Li 1957, 454–5). Honda (1995, 93) also mentions another undated Ming dynasty daily-life encyclopedia, the *Xinqie bowen shenglan kaoshi quanshu* 新鍥博聞勝覽考實全書, that contains a mathematical chapter with the equivalent text passage.

Table 1 (continued)

	盤珠算法 (1573)	五車拔錦 (1597)	三台萬用正宗 (1599)	文林聚寶 萬卷星羅 (1600)	萬用正宗 不求人 (1609)	萬書淵海 (1610)	五車萬寶全書 (1614)	算法統宗 *juan 17*(1592)
Pudijin 鋪地錦 (Gelosia-method)[51]	*[52]	*	*	*		*		*[53]
掌中定位 Finger positions illustrated, with rhyme	*	*	*	*		*		*
算堆垛法 Calculating finite series	*		*					*
Fate calculation with rhyme			算病死生訣[54] 亥子算法[55]					孕推男女法 [56]

[51] Lit. "to spread out thin brocade/embroidery on the ground", this expression denotes certain weaving techniques, but also a herb used in Chinese medicine (*Callisia repens*).
[52] The method is here only mentioned by its name, the remark that "without using the abacus, one can see the total by multiplication with units (*yin cheng* 因乘)", and a numerical example for multiplication. Obviously the editor did not have access to the precise method, neither to the diagram that would show the matrix layout of the numbers as in the other sources.
[53] *Suanfa tongzong* 17:3b ff. The Gelosia-method of multiplication is a kind of "written calculation" (*xiesuan* 寫算). This method has been transmitted from Arab countries in the 15th century and does not use the abacus. See (Cheng 1990, 995–6 note 3).
[54] An algorithm to calculate whether a sick person will die or not according to his age and the time of incubation. The versified form of the algorithm here is supposed to be sung according to the Tang tune *Moon at the Western River* (*Xijiang yue* 西江月). See (Santai *juan* 22:13a–13b). This tune occurs together with other poems (*gejue* 歌訣) in several other mathematical writings, see for example (Wu 1993, 4:39b–41b), my footnote 21 and (Bréard forthcoming b).
[55] An algorithm to calculate whether a pregnant women's baby will be a boy or a girl according to her age and the duration of pregnancy.
[56] *Idem*. See (Cheng 1990, 17:25b).

the former do not have a uniform content, whereas the latter, although appearing in different chapters, show an entirely identical text in all the encyclopedias. It is likely that popular and possibly orally transmitted mathematical procedures were represented and transcribed in their local diversity, whereas the game of dominos, which was originally an occupation of the elite class was normalized through central authority. The winning combinations given with the rules of the game were standardized through an imperial edict which possibly eliminated regional variations.

*Sections on Mathematical Methods (***Suanfa men** 算法門*)*

Mathematical methods do form a separate chapter in the *Complete Books* from the earliest editions on. As in the usual layout of these sources, two texts are printed one above the other. In the case of mathematical methods, we generally find problems with solutions on top and arithmetical rules written in verse for abacus calculation at the bottom. In addition some have illustrations at the beginning of the chapter and some sections of general discourse on the origins of mathematics. Table 1 summarizes the occurrences of the main section headings in each of the sources under consideration and compares them with two other contemporary sources. Although there are many similarities in content between the editions, the ordering, precise wording and the numerical values of the miscellaneous problems vary from one to another.

For at least three reasons one might conclude that the *Unified Lineage of Mathematical Methods* was an exception with respect to late Ming mathematical traditions: the rhymes for finger calculation and the Gelosia-method of multiplication are distinctly different from the ones given in the *Complete Books* from Jianyang,[57] and the illustration of the abacus also differs from all the others. In the *Unified Lineage of Mathematical Methods* the "dividend" and the immobile "divisor" are represented on the left and right parts of the abacus respectively. The *Complete Books* only label the consecutive columns with numbers from one to nine, but do not distinguish between dividend and divisor columns. (Fig.1)

Furthermore, in the section on large and small numbers, the order of the numeral associated to each expression does not correspond to what the *Complete Books* give.[58] *Santai's orthodox instructions for myriad uses* (*Santai wanyong zhengzong,* 1599), for example, proceed by powers of ten:

$10\times10^4=10^5=$:yi (十萬為億),
$10\times10^5=10^6=$:zhao (十億為兆),
$10\times10^6=10^7=$: jing (十兆為京) . . .,

[57] See the appendix for the variations in wording.

[58] Different ways of numbering (superior, medial and inferior numbering 上中下數) have been recorded in an earlier source, the *Shushu jiyi* 數術記遺 (late 2nd to early 3rd cent. AD). See (Volkov 1994) on a discussion of large numbers in relation to religion.



Fig. 1 Illustrations from the *Unified Lineage of Mathematical Methods* (private collection)

whereas the *Unified Lineage* proceeds by 10^8:

$10^4 \times 10^4 = 10^8 =:$ yi (萬萬曰億),
$10^4 \times 10^4 \times 10^8 = 10^{16} =:$ zhao (兆萬萬億);
$10^4 \times 10^4 \times 10^{16} = 10^{24} =:$ jing (京萬萬兆), etc.

where these differences simply geographical variations, since Cheng Dawei's book was printed in Anhui province and all the other sources in Fujian? Or could Cheng have used a broader variety of printed material and thus select passages that partly coincide and partly do not coincide with the *Complete Books*? Judging from Cheng's appended list of all the mathematical books that he had seen or heard of, and the fact that he had traveled much around the country to collect them, the second hypothesis seems more plausible.

Among the group of Jianyang imprints, *Santai's orthodox instructions for myriad uses* (1599) seem to occupy a particular position. Not only is it the one that corresponds most in structure and content to the "'miscellaneous methods"' at the end of Cheng Dawei's *Unified Lineage*, but it also contains sections and expressions that are not found in other sources. It is hard to say whether these additions were made by the compiler Yu Xiangdou 余象斗 himself,[59] nor

[59] See his biography in (Goodrich & Fang 1976: vol.2: 1612–14). Kathryn Lowry labels these compilers, who excerpted and arranged the essentials of many books into one "book of books" for easy reference rather as "journeyman-editors". Communication at the REHSEIS in Paris, April, 23rd, 2006.

do we know whether he knew the *Unified Lineage*. But even if he was only selecting excerpts from other sources we can assume that these additions do reflect his editorial intentions to address a wider and less proficient reading public. The illustration of women teaching the "Six Arts" to children, of which mathematics was one, supports Yu's universal education goals and imagined audience of the "four folks under heaven" (*tianxia simin* 天下四民). It bridges the gap between Confucian elite education and instruction of the common people.

The same holds for the mathematical content in all the Jianyang imprints. Mathematical problems are presented from the daily life of merchants, government officials, accountants, astrologers, children, cooks, and others. Moreover, as mentioned earlier, the methods given are often entitled "'secretly transmitted methods"' (*Mizhuan fa* 秘傳法),[60] which underlines the idea that the reader here gets original access to knowledge previously restricted to a privileged social group.[61]

But not everything in Yu Xiangdou's encyclopedia should be seen in the light of audience-orientation or market-dependency. References to Antiquity, earlier or foreign methods might also be interpreted as a concern for completeness and inclusiveness. For one subtraction procedure for example it says:

> This subtraction method is called 'body determined elimination method (*dingshen chufa* 定身除法)'. Former masters of mathematics only used this. Nowadays we have the 'mixing and returning method (*hungui fa* 混歸法)' which is even more exquisite. So we don't need to use the [old] method any more. But, because the Ancients have established it, I do not dare to omit it.[62]

In another passage on "large numbers" (*dashu* 大數) Yu Xiangdou comments on such expressions as '*the sands of the Ganges'* (*henghe sha* 恆河沙) and "unmeasurable numbers" (*wuliang shu* 無量數)[63] for the largest numbers by juxtaposing them with expressions used by the Ancients (*guren* 古人). By including both, old and new, the encyclopedia provides historical information not only to the readers but also to the historian of science today. I will discuss the particular values of the *Complete Books* in the last section after the following analysis of rubrics on one particular game of chance.

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[60] Cf. (*Santai wanyong*, 22), "*jinchan tuogu mifa* 金蟬脫鼓秘法", "*Mizhuan haizi suanfa* 秘傳亥字算法", "*Mizhuan pudijin* 秘傳鋪地錦".

[61] Harper (in this volume) points out that occult texts now available to us in manuscript ... "reflect a popularized culture of secrecy shared among the elite who read and used occult miscellanies."

[62] (*Santai wanyong* 22:10a).

[63] Cf. (*Santai wanyong* 22:3a). The *Unified Lineage* (Cheng 1990, 1:4a) also gives these two expressions, but does not comment on them.

*Ivory Tiles (***yapai** 牙牌*)*[64]

The Chinese game of domino, literally called "'ivory tiles"', constitutes a section in chapters on games, ritual caps, and lute playing in the late Ming editions, but the detailed description of the odds in this game disappears from the content of the *Complete Books* by the early Qing. What remains are the pattern sheets representing the domino combinations with their respective names. These pattern sheets, as the introductory essay to the "'ivory tiles"' text passage recounts, go back to the year 1120. A certain government official then memorialized to the throne asking that the ivory tiles might be fixed as a pack of 32 (12 pairs and eight singles, with the numbers one and four painted in red pips and the others in black). But we are told that "because his tables [i.e. his pattern sheets] were highly elevated (*yi* 屹), they were hidden away in the Imperial Treasury. Sensing that they were too complicated they were not circulated." Emperor Gaozong (r. 1127-–1163) finally issued pattern sheets by imperial edict that standardized the names and combinations of tiles. This, the legend in the *Complete Books* says, allowed "all the recluse and scholars under heaven to find pleasure in playing a battle of wits in order to decide upon loss and gain, although for a loyal statesman this is not an affair of honoring one's parents."[65]

The pattern sheets appear in other (earlier and later) sources showing not only the names of the combinations but also the line of the Tang poem and its author from which the name of each combination was derived.[66] But only the late Ming *Complete Books* give the schemes for rewarding the winning combinations of two, three, six or eight dominos with two, three, four, five or ten counters. One editor claims that his "family discussed the matter and decided to continue transmitting its [the ivory tile game's] beauty to the later generations (*zu bian wu jishi chuanfan qi mei* 族辯物繼世傳橎其美)."[67] Although he is not unique in including a section on ivory tiles, his statement refers to an intention to make practices of chance previously restricted to the elite available to a wider public.

Looking at these games from a mathematical point of view, we note that certain combinatorial reflections were at stake to determine the odds.[68] Whether these were done through calculation or complete enumeration is unclear, although the latter seems unlikely considering the number of possible

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[64] According to the material they were made of, these were also called "bone tiles" (*gupai* 骨牌). See for example (Xie 2001, 卷六 《人部二》). Jin (1998, 3b) also mentions tiles made of horn (*jiao* 角), wood (*mu* 木), or bamboo (*zhu* 竹).

[65] Cf. (*Santai wanyong* 10:1a–b). Jin Xingyuan (fl. 1757) also states that this game was first played in the imperial palace during the Song. See (Jin 1998). According to (Xie 2001, 125) "this game is about as noble as the game of *zhuwo* 朱窩 [a dice game], but requires less efforts than the game of *Go* (*weiqi* 圍棋)."

[66] See for example Qu You (1341–1427), *Xuanhe paipu* (Register of Dominos in the Xuanhe Era) and Xie Zhaozhe (1567–1624), *Wu zazu* (A five-fold miscellany).

[67] Cf. (*Santai wanyong* 10:1b).

[68] For more details see (Bréard forthcoming a).

combinations for each outcome. To obtain from the set of dominos for example eight tiles all black (e.g. no tile with one or four pips), we have 6,435 possibilities. There is one extant mathematical manuscript from the late seventeenth century or early eighteenth century that shows that the author, Chen Houyao陳厚耀, understood perfectly well combinations and permutations.[69] He also solves a kind of combinatorial problem relevant to games of chance: how many possibilities are there to draw six cards out of a set of thirty. Although this text is a singular occurrence and was written a century later after the first *Complete Books* came into print, it is not impossible that by the end of the sixteenth century such combinatorial knowledge had already circulated and was applied to the design of games of chance. But one can also interpret this the opposite way in terms of bodies of knowledge shaped by sources like the *Complete Books*. Did scholars like Chen Houyao integrate in the field of mathematics games of chance as a new context of problems? Since mathematical procedures and card, dice and domino games were all described in the *Complete Books*, these commercial imprints might have played a role in redefining the field of mathematics.

Coming back to the link between certain kinds of knowledge presented in the *Complete Books* and the scholarly tradition, I had already mentioned the origin of the names of domino combinations in lines from the Tang poems. But the domino combinations do show another link to scholarly occupations. Literary in its genre, several "'verses for use in drinking games"' (*jiuling* 酒令) described in a separate chapter in the *Complete Books,* require one to compose poems that contain citations from vernacular novels, dramatic texts, popular songs, the Confucian Classics and/or names of domino combinations, exactly those as found in the pattern sheets. Let me illustrate this with an example from a chapter on drinking games played at banquets (*Youshang* 侑觴) in *Santai's orthodox instructions for myriad uses*. The game asks players to combine phrases in particular relations of harmony according to the following pattern:

> You need to link three names of bone tiles (*gupai* 骨牌)[70] and make their meanings correspond to each other. [It follows a first example:]
>
> 'The Chu and the Han Kingdoms are struggling for mastery' ('楚漢爭鋒').[71]
>
> Having removed (折了) 'the disliked/hatred dot, not reaching the top' ('恨點不到頭)[72]
>
> they injured/wounded (傷了) 'the regular cavalry' ('正馬軍')[73].[74]

[69] Chen Houyao 陳厚耀. *Cuozong fayi* 錯綜法義 (The meaning of methods for alternation and combination).

[70] Dominos similar to the "ivory tiles", but made of bone.

[71] I.e. the combination of the two dominos [6 5][6 5].

[72] I.e. the combination of the three dominos [6 6][6 5][6 6].

[73] I.e. the combination of the three dominos [4 4][5 5][6 6].

[74] (*Santai wanyong, juan* 19:11a). For the early history of such drinking games see (Wang 1995).

For this particular type of composition it was enough to be familiar (and ingenious) with the domino patterns or to have the pattern sheets at hand, but others required fluency in classical or vernacular literature and were thus clearly not only a recreation of the non-educated class. Included in the *Complete Books*, these games did not only give the readers insight into the daily life of the literati circles, but also provided these with a reference for leisurely activities.

"Mathematics" as Part of Late-Ming Daily Praxis

So far we have seen that the *Complete Books* offer a comprehensive representation of the quotidian mathematical practices in diverse social contexts. Their textual construction from end of sixteenth to beginning of twentieth century reminds us that the organization of knowledge is based on intellectual conventions and social structures that undergo historical change. In that respect these encyclopedias contribute to the picture of mathematical praxis in its entirety, since they complement the better studied sources that have been transmitted through official sanction or patronage. Not unlike the division of the *Unified lineage of mathematical methods* into a canonic tradition following the *Nine Chapters,* two introductory chapters and miscellaneous methods (*zafa* 雜法), does the traditionally studied corpus of mathematical writing in China reflect the first tradition, while the *Complete Books of a Myriad Treasures* belong to a different textual genre that did not fit into conventional categories and has thus been marginalized in historical processes. In contrast to officially approved or imperially commissioned compilations, these sources incorporated a large repository of non-standardized discourse and reference of the time.

Contrasting what the late Ming Jianyang publishers explicitly classified as mathematical knowledge with what I would regard as mathematical practice, it turned out, that the so called mathematical chapters vary greatly from one edition to another whereas the description of the domino game has a stable identity. Even if the mathematical chapters, somewhat miscellanies of problems, rhymes, illustrations assembled together in a loose order, show a similar mathematical content in the studied Jianyang editions, the many variations in wording and numerical examples are in stark contrast with other chapters, for which entire woodblocks were reprinted from other editions. From variations in the rhymes of mathematical procedures, we can analyze the significance of relations between the formulation of an algorithm, the prescribed mathematical operations, and the instruments used for calculation. Indications are also found concerning the intercultural transmission of mathematical methods or concepts. A type of written calculation, the *Gelosia* method of multiplication (*Pudijin* 鋪地錦), found in fourteenth and fifteenth century European and Arab manuscripts for example, appears in China in a 1450 source.[75] The fact

[75] I.e. Wu Jing. *Suanfa bilei daquan* 算法比類大全. See (Martzloff 1997, 92) and (Wu 1990).

that it is found in many editions of the *Complete Books* shows that this was not a singular occurrence, but that it also circulated widely and eventually by 1600 used for written calculations in commercial transactions.

Integrating late-Ming imprints into the study of the history of science in China can thus contribute to the social differentiation in the knowledge and practice of mathematics between popular encyclopedias and the literati kinds of writings. Although they were an audience-oriented and market-dependant set of discourse practices, they were nevertheless confined by specific local social and cultural conditions which make them a valuable source for the historian of science interested in the circulation and variations of knowledge and practices between social and cultural milieus in time and space. They allow us to better understand the uses of mathematical knowledge in relation to its social and material context in which it is produced. By observing how knowledge, mainly known to the historian through literati sources, is combined into other bodies of knowledge—for example gaming and divination—we will have to reconsider the dichotomy between elite and "popular" mathematical culture.

Appendix: Variations of lyrics for the « Gelosia » method (*Pudi jin* 鋪地錦)

1. *Wuche bajin* 2: 431

。秘傳鋪地錦　歌曰
數代因乘法更奇　鋪地錦名捷徑扁
置實先當橫上位　但為法者右傍添
縱橫格定仍斜界　九九相因上下牽
遇十須施斜格上　逢單即何下層宣
數來單予作成數　有十還當趲向前
算者從斯能觸數　厘毫絲忽不差焉

2. *Santai wanyong* 4:353

。秘傳鋪地錦
數代因乘法更奇　鋪地錦名捷徑篇
置實先當橫上位　但為法者右傍添
縱橫格定仍斜界　九九相因上下牽
遇十須施斜格上　逢單即何下層宣
數來單予作成數　有十還當趲向前
算者從斯能觸類　厘毫絲忽不差焉

3. *Wanshu yanhai* 7:313

。秘傳鋪地錦　歌曰
數代因乘法更奇　鋪地錦名捷徑篇
置資先當橫上位　但為法者右傍添
縱橫格定仍斜界　九九相因上下牽
遇十須施斜格上　逢單即何下層宣

數來單予作成數　有十還當趲向前
算者從斯能觸數　厘毫絲忽不差焉

4. *Wuche wanbao quanshu*
The chapter on mathematical methods (*juan* 17) does not contain this algorithm.

5. *Wanyong zhengzong* 10:549
。秘傳鋪地錦
數代因乘法更奇　鋪地錦名捷徑人
置实先當横上位　但為法者右傍添
縱横格定仍斜界　九九相因上下牽
迈一□□爵施斜格上　單逢即何下層宣
數來單予作成數　有十还當趲向前
算老從斯能能數　厘毫絲忽不差焉

6. Cheng Dawei. *Suanfa tongzong* 17:3b
。寫算　即鋪地錦
寫算鋪地錦為奇　不用算盤數可知
法實相呼小九數　格行寫數莫差池
記零十進於前位　逐位數上亦如之
照式回圖代乘之　厘毫絲忽不須施

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Is the Lower Yangzi River Region the Only Seat of Medical Knowledge in Late Imperial China? A Glance at the Far South Region and at Its Medical Documents

Florence Bretelle-Establet

Since the 1980s, the study of the social and cultural history of medicine in Qing China (1644–1911) has been, in one sense, much easier than it had been before. For historians, access to source materials has been facilitated during the last two decades through the publication of numerous useful tools such as dictionaries of medical sources and catalogues of books in Chinese libraries.[1] In another sense, the work has been complicated because historians now know that they have access to a daunting bulk of literature. For example, according to the *Catalogue of Medical Books in Chinese Libraries* (*Quanguo Zhongyi tushu lianhe mulu* 全国中医图书联合目录) which lists the medical books available in 113 major libraries in China, of the 12,124 extant medical books, approximately 11,129 (or 92%) were written from 1600 onwards.[2]

Such a huge amount of primary literature available in Chinese libraries obliges historians to make selections in order to research medicine in late imperial China. This chapter tackles precisely that question. It first outlines how historiography of medicine in late imperial times has generally relied on medical documents that were produced in one specific area – namely, the Lower Yangzi region which spreads over the major parts of the provinces of Jiangsu, Zhejiang and Anhui, known collectively as Jiangnan ("South of the

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[1] Among these catalogues, see (Guo Aichun 1987; Xue Qinglu 1991; and He Shixi 1991). I wish to express my gratitude to the other members of the editorial board and to the anonymous referee selected by the Boston Studies in the Philosophy of Science for their valuable comments. I am also grateful to Zhu Jianping, (China Institute for the History of Medicine, Academy of Traditional Chinese Medicine) for his help in locating and copying the medical texts that are quoted here and to Zhen Yan, from the same institute, for the corrections she made on my translations of these Chinese sources. Finally, my thanks go to Maurice Shukla and Richard Kennedy for their help in polishing the English in the paper. I am nevertheless fully responsible for the remaining shortcomings.

[2] From a personal account of the 1003 pages of (Xue Qinglu 1991).

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F. Bretelle-Establet (ed.), *Looking at It from Asia: The Processes that Shaped the Sources of History of Science*, Boston Studies in the Philosophy of Science 265,
DOI 10.1007/978-90-481-3676-6_11,

Yangzi river") – and ignores nearly everything that has been produced outside this area. This contribution then explores the reasons why documents from Jiangnan have been at the foreground of historiography. In that respect, this study highlights the mechanisms prior to the work of historians which led to the prominent place assigned to Jiangnan medical culture in the medical landscape of the empire. This study considers how differentiations were made among the documents by the Chinese themselves under the Qing dynasty, through the compilations undertaken in the eighteenth century commissioned under imperial patronage. Finally, it studies what is at stake for the social and cultural history of medicine in Qing China by reconsidering some medical documents which official Chinese circles marginalized at the time they were written and which modern historians have continued to neglect. To do this, this study examines specifically medical literature produced in the provinces of Yunnan, Guangxi and Guangdong in the far south of China.

The Lower Yangzi (Jiangnan) Region at the Center of the Historiography of Medicine in Late Imperial Times

From General Perspectives to Narrower Fields of Research

The focus on the history of medicine in late imperial times is a recent trend in the historiography of Chinese medicine. In the last two decades, indeed, medicine in China has been the object of an extensive scholarly literature which shifted from general scopes to narrower perspectives.[3] Different reasons explain this change. As T.J. Hinrichs and other scholars have underlined, the historiography of Chinese medicine in the twentieth century has been moulded by the various political tensions that have affected Chinese medicine in China and abroad. Without entering into detail in this well-known historiography, the most important features of it should be emphasized. Until the 1950s, the historiography of medicine in China was mainly done in China. The status of these historians together with the political tensions that surrounded Chinese medicine left their hallmarks in this early historiography. As practitioners of a tradition threatened with disappearance and scholars concerned with the international view of China as backward, these historians were particularly anxious to demonstrate the scientific progress of Chinese medicine in the long course of its history. Such positivist approaches, nourished by strong feelings of nationalism leading to the establishment of Chinese priorities and the discovery of precursors to present-day knowledge, have not disappeared from the historiography of Chinese medicine, even though new approaches have emerged. This particular practice in the history of science also informed J. Needham's pioneering project on the

[3] For an extensive review of this literature, see (Hinrichs 1998) and (Sivin 1988); (Hanson 1997, 42–8) and (Zhu Jianping, 2003, 224–81) particularly focused on what had been published in mainland China.

history of science in China, for another motive though. Convinced that modern science was international in character and striving to counter the dominant views that the origins of science were limited to the West, he made it a goal to find evidence of "scientific" knowledge in ancient Chinese sources.[4]

In the late 1970s, a newly re-opened China allowed Western scholars more direct access to the nature of Chinese medicine, which, in the meantime, had become the object of a renewed interest in Europe and North America, which were engaged in countercultural movements and sought alternatives to a scientific though potentially harmful medicine. This growing popular acceptance of alternatives to biomedicine gave rise to numerous popular publications and to several scholarly studies that provided a useful basis for understanding Chinese medicine. However, as Kim Taylor stressed, these latter works relied on a set of modern Chinese textbooks compiled for teaching Chinese medicine to Chinese doctors who had trained in Western medicine, according to the slogan "Doctors of Western medicine study Chinese medicine," put forth by Mao Zedong in 1954 in order to prepare for the "integration of Chinese and Western medicine", another slogan introduced in 1958. Because of their target audience, their pragmatic function, and because of the source material they relied on, these works were synthetic, a-historical and a-contextual. Furthermore, they focused on essential conceptual contrasts between Chinese and Western medicine and contributed the image of Chinese medicine as a single coherent system of thought.[5]

Other approaches emerged at the same time, as anthropologists introduced the perspective of medicine as a "cultural system" and paid more attention to the social context of its production and its negotiation.[6] Informed by such perspectives, and taking advantage of better access to Chinese sources after the beginning of the 1980s, historians moved away from their former approaches. Instead of considering Chinese medicine as a set of concepts and healing practices which could be preferable alternatives to biomedicine or searching for "scientific" knowledge in Chinese sources, historians took a new direction. Paul U. Unschuld, a major representative of this new approach, considering a corpus of medical texts dating from the Han period to the twentieth century, made it his goal to shed light upon the theoretical and clinical changes that affected medicine in China as the socio-economic and socio-ideological contexts changed.[7]

Since the end of the 1980s, new catalogues of sources have been published in China, revealing a profusion of primary literature. In response, the mainstream of Western scholarship has narrowed the breadth of its focus. Limiting their

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[4] The first volume of *Science and Civilization in China* appeared in 1954. For a review of J. Needham (1900–95)'s project, see (White and Spence 1984; Elvin et al. 1980; Blue 1997).

[5] (Taylor 2004).

[6] In this current, see (Kleinman 1980) and (Leslie 1976).

[7] (Unschuld 1985).

field of research to one particular period of time or to a particular place,[8] or analyzing medicine from a limited perspective such as diseases[9] or gender issues,[10] Western scholars have paid more attention to the context in which knowledge was produced, transmitted or changed. This reduction in scale was paralleled in Chinese historiography as political control in mainland China slackened and inter-regional competition for prestige increased. The subdivision of the Chinese Central Society of the History of Medicine (*Zhonghua yixuehui yishi xuehui* 中华医学会医史学会) into a growing number of regional societies (as many as 16, in 1995), encouraged to organize regional symposiums since 1994, has given rise, for instance, to an increasing number of micro-historical studies that focus on limited areas.[11]

This wide range of scholarly literature produced the "new geographies" of Chinese medicine discussed by Hinrichs. Whereas the essentialist approaches of the late 1970s and early 1980s set China in opposition to the West and treated Chinese medicine as a static and a unitary system, the development of new approaches, informed by multiple disciplinary perspectives, have exposed the complexities, discontinuities, pluralities and contradictions of medicine in China. Even though the former approaches have not totally disappeared from the historiography, the last three decades of scholarship in the field of medicine in China have contributed to breaking the image of a coherent system of knowledge that has remained unchanged for two millennia of history.

The Jiangnan Region at the Center of the Historiography of Late Imperial Medicine

Thus, over the historiographical changes of the last three decades, some historians have narrowed their focus on medicine in late imperial times, including the Ming (1368–1644) and Qing Dynasties (1644–1911). Precise

[8] For ancient times, see (Keegan 1988; Nakatani 2004). For medical history of the Song and the Jin dynasties, see (Hinrichs 2003; Goldschmidt 1999; Wu Yiyi 1993); For an history of medicine under the Yuan, see (Shinno, 2002); For late imperial period, see (Hanson 1997; Wu Yi-li 1998; Bretelle-Establet 1999; Chao, Yuan-ling 1995; Grant 2003). For modern period and interaction with Western medicine, see (Wang Hsiu-Yun 2003; Nakajima 2004; Andrews 1996; Lin Sean Hsiang-Lin 1998; Rogaski 1996 and Yip Ka-chi 1995). For contemporary China, see (Jia Huanguan 1997; Hsu 1999 and Taylor 2000).

[9] (Benedict 1996 ; Despeux & Obringer 1997; Chang Chia-feng 1996; Shapiro 1995; Leung Ki-che 1987, 2003)

[10] (Furth 1999; Wilms 2002; Wu Yi-Li 1998; Leung Ki Che 1984).

[11] For an overview of this society and the general trends of the Chinese historiography of medicine, see (Zhu Jianping, 2003, 224-262); (Tian Jingguo 1987; Lin Shiquan and Yang Caixu 1988, Lin Shiquan 1993) focusing especially on the far south of China are a few examples of this new regional trend in Chinese historiography of Chinese medicine.

contributions relating to state's and private agencies' role in medical assistance,[12] the social and cultural evolution in the community of physicians and in medical writings,[13] the competition between the main medical currents of thought,[14] and the religious strategies for fighting against disease,[15] have opened a window on the social and cultural landscape of medicine and healing strategies in late imperial China.

However, when scrutinizing the sources and actors selected for this historiography, one may be tempted to believe that the Lower Yangzi region, or Jiangnan, was the only place which had medical texts and medical practitioners. Indeed, scholars have mainly looked at Jiangnan when examining the social and cultural history of medicine and healing strategies in late imperial times. Two approaches that, very likely, had chronological roots must be distinguished, though. Firstly, when illustrating medical knowledge in late imperial times in comparison with previous periods, historians selected a number of authors and analyzed their texts. These historians, however, did not feel necessary to give details on these particular authors nor did they feel necessary to explain the reasons which had led to their selection. Joseph Needham, as a first example, recalling that therapists could be found at every level of the society displaying diverse healing practices, explained that his concern was "learned medicine and its written traditions".[16] Pointing out that late imperial medicine conveys the impression of a "complex labyrinth" in which "thinkers seeking solutions to medical questions wandered aimlessly in all directions," Paul Unschuld, as a second example, informed his readership that he would only provide outlines of the approaches taken by some of these thinkers.[17] Only when looking at the bibliographies of these two fundamental works and checking them against dictionaries of physicians' biographies, can one see how Jiangnan-centred this historiography is. In the first example, 19 out of 23 quoted Ming and Qing authors originated from Jiangnan area.[18] In the second example, 15 of the 18 quoted Ming and Qing authors hailed from Jiangnan.[19] Secondly, more recently, in order to open a window on the cultural and social history of medicine in late imperial times, scholars have deliberately and explicitly chosen the specific area of Jiangnan. In fact, it is mainly within the limits of Jiangnan that the above mentioned scholars analyzed the role of the state and local agencies in medical assistance, the

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[12] See in particular (Leung 1987a; Benedict 1996).

[13] See (Chao Yuanling 1995; Grant 2003; Furth 1999; Cullen 2001).

[14] See notably (Hanson 1997; Wu Yi-li 1998; Grant 2003; Unschuld 1985; Needham and Lu Gwei-djen 2000).

[15] (Katz 1995; Benedict 1996).

[16] (Needham and Lu Gwei-djen 2000, 40).

[17] (Unschuld 1985, 197–198).

[18] (Needham and Lu Gwei-djen 2000, 205–11).

[19] (Unschuld 1985, 189–228).

social and cultural landscape of physicians, and religious strategies against disease. Although both trends of scholarship differed slightly in character, they have both relied on corpuses of documents produced in the Jiangnan region. Likewise both trends have had consequences for the image of medicine in late imperial times. One is tempted to think either that only Jiangnan produced medical writings or that what was thought and written in Jiangnan about the medical field could be extended to the rest of the empire, as if medicine in late imperial China had been a coherent and unique system of thought.

One may wonder why historians focused on this area. Undoubtedly, the Jiangnan region was the best growing area for tea, rice and fruit and had become a center of production for silk and cotton goods. Furthermore, Jiangnan had an advantageous position in trade and commerce and had played a major role in the economy of the Empire since the middle of the Tang dynasty (618–907). True, Jiangnan was also *un lieu de savoir*. The provinces of Jiangnan produced the major raw materials required for woodblock printing and had been centers of book-production for centuries. These provinces enjoyed a high concentration of academies as well as major libraries and produced the highest number of successful candidates in the imperial examinations.[20] In the field of medicine, many books were actually written there. 4,000 (or, 55%) of the 7,200 medical books recorded by local gazetteers for all the empire had been written by authors based in Jiangnan.[21] Undoubtedly then, this region teemed with medical books and physicians. However, my assumption is that this area and its medical culture were also given a prominent place in the medical tradition of Qing China, thanks to its powerful elite who succeeded in imposing its culture, notably through the editorial projects under imperial patronage in the eighteenth century. In fact, medical documents, as we will now establish, were not subject to the same treatment in the course of their historical preservation and promotion.

The Imperial Editorial Projects in Eighteenth Century: The Selective Preservation of Scholarly Documents

Imperial Patronage of Medicine: From Production of Texts to Promotion of Doctrines

During the eighteenth century, three imperial editorial projects involving medical knowledge were completed. First, the *Collection of the Books of Past and Present*

[20] (Elman [1984] 2001, 178–208).

[21] (Hanson 1997, 331–335) on the basis of (Guo Aichun 1987). Local gazetteers *fangzhi* (方志) are official sources which were regularly written by local scholars in order to provide the central court with cultural, economic, demographic data on the different administrative units of the Empire. On this type of source, see (Will 1992).

(*Gujin tushu jicheng* 古今图书集成), or imperial encyclopedia, was undertaken by emperor Kangxi and published in 1728. In later commissions by emperor Qianlong (in 1739 and 1772 respectively), the *Golden Mirror on the Orthodox Medical Lineage* (Yuzuan yizong jinjian 御纂医宗金监) was published in 1742 and finally the *Complete Library of the Four Treasuries* (Siku Quanshu 四库全书) was completed in 1782.

The eighteenth century was not the first time in Chinese history when medical writings had imperial patronage. Since the seventh century, medical books or compilations of medical formulas had regularly been commissioned by the emperors either to serve as manuals in the Imperial Bureau of Medicine, the *Taiyi yuan* 太医院, or to be distributed throughout the empire to supplement the deficiencies of the central medical assistance.[22] The *Treatise on the Origins and the Symptoms of Disease* (*Zhubing yuanhou lun* 诸病原后论) and the *Prescriptions Worth a Thousand Gold (Qianjin fang* 千金药方) written in the seventh century, the *Holy Benevolent Prescriptions (Taiping sheng hui fang* 太平圣惠方), the *Formulary of the Taiping Welfare Dispensary Bureau (Taiping huimin he ji ju fang*太平惠民和剂局方) and the *General Medical Collection of Royal Benevolence (Shengji zonglu* 圣济总录) written respectively in the tenth, twelfth, and thirteenth centuries are just a few examples of medical works that were commissioned by different emperors and added to the official curriculum.[23] They testify to a long tradition of imperial patronage of medicine and indicate that the central power played a role not only in the production of medical documents but also in the circulation and promotion of certain texts and theories.[24]

The Golden Mirror on the Orthodox Medical Lineage *and the* Complete Library of the Four Treasuries: *The Promotion of Voices from Jiangnan*

In the eighteenth century, then, three imperial collections containing medical knowledge were completed. According to Marta Hanson's thorough analysis, the nature and function of these imperial projects were quite different. With regard to medicine, the first project, the *Collection of the Books of Past and Present*, brought together medical sources but without any clear attempt to impose any specific medical orthodoxy. By contrast, through the editorial

[22] For a good understanding of this long lasting imperial institution, see (Gong Chun 1983).

[23] On these medical treatises or compilations, see in this order (Despeux and Obringer 1997, 143–144 and Gong Chun 1983, 68); (Shinno 2002, 54; Needham and Lu Gwei-djen 2000, 56 and Gong Chun 1983, 75); (Li Lin 1997 and Ma Jixing 1990, 173); (Ma Jixing *ibid*, 173–176; Shinno 2002, 100; Gong Chun 1983, 84).

[24] On imperial patronage of medicine and science in general, see (Jami 2003; Hanson 2003; Chao Yuanling 1995, 99).

process of selection and correction of texts, the second and third editorial projects, the *Golden Mirror on the Orthodox Medical Lineage* and the medical section of the *Complete Library of the Four Treasuries*, definitely imposed the authority of one particular group of authors: those who were based in Jiangnan. Hanson invites us to see a shift from "an encyclopaedic to a hegemonist editorial work" or a development "from collection to selection to representation".[25]

Indeed, unlike the *Collection of the Books of Past and Present*, the *Golden Mirror on the Orthodox Medical Lineage* (hereafter *Golden Mirror*) was composed with a specific agenda: to rectify errors in medical learning, as had been explicitly demanded by the emperor Qianlong. Accordingly, the editors in charge of the project produced a medical compendium which combined newly composed critical editions of classical sources from the Han dynasty (–206; + 220) and short monographs on different diseases. Even though the main part of this compendium is anonymous, it is nonetheless possible to detect the regional dominance of Jiangnan, notably in the first two sections containing the critical editions of the *Treatise on Cold Damage Disorders (Shanghan lun* 伤寒论) and the *The Essentials of the Golden Casket (Jinkui yaolüe* 金匮药略) of Zhang Ji (ca: 150–219) and in the sections devoted to the formulas prescribed by famous physicians. All of the Ming and Qing authors selected either for editions of Han texts or for treatments prescribed or for comments on famous treatments in fact hailed from Jiangnan.[26]

The prominent place given to Jiangnan medical authors was further emphasized in the last imperial editorial project, the *Complete Library of the Four Treasuries* (*Siku Quanshu*, hereafter *SKQS*). This empire-wide book-collection project was also launched by the emperor Qianlong to enrich the imperial library. To perform this project, local authorities created official book bureaus in provincial capitals. These bureaus were required to compose a list of the valuable books within their jurisdiction and to deliver this list to the court. At the court, a commission ranked the books that had been submitted; but it was the emperor who finally decided whether books would be copied in full, quoted in an annotated catalogue as extant, ignored, or destroyed. The result of this project was, on one hand, the destruction of over two thousands works and, on the other, an enormous bringing together of extant documents from the different fields of knowledge: 3,697 books were copied in their entirety to compile the *SKQS* and 7,038 books were listed as extant with a short abstract in an *Annotated Catalogue*, the *Siku quanshu zongmu tiyao* 四库全书总目提要.[27] In the medical part of the *SKQS*, 97 medical books were copied completely. In the *Annotated Catalogue*, one hundred other titles were listed as extant, including 6 veterinary books.

[25] (Hanson 1997, 182–219; Hanson 2003).

[26] (Wu Qian [1742] 1997, Section 1, 2 and 26).

[27] This compilation, addressed in this volume by Chu Pingyi, Andréa Bréard and Karine Chemla, gave rise to numerous publications in China and abroad analyzed by (Boettcher Tarsala 2001, 11–26). For an overview of it, see (Guy 1987).

Unlike the *Golden Mirror*, the medical part of the *SKQS* is a compilation of entire books whose authors were generally well identified, beginning with the Han period and continuing until the end of the eighteenth century. Tables 1 and 2 indicate the regional origin of the authors whose books were selected to be copied in the *SKQS* for the Ming and Qing dynasties. Tables 3 and 4 follow the same pattern for the books that had been listed as extant in the *Annotated Catalogue*. As these tables show, the collection of medical books copied in the *SKQS* or listed as extant in the *Annotated Catalogue* for the Ming and Qing periods gave prominence to authors from Jiangnan: 82% of the books copied from the Ming and 100% of the books copied from the Qing came from authors based in Jiangnan, while 69% and 62% of the books listed as extant from the Ming and Qing respectively were written by people who hailed from Jiangnan.

As mentioned earlier, this region teemed with medical books in Ming and Qing times. However, if half of the medical literature produced in late imperial times was in fact the work of people based in Jiangnan, the other half was written outside this area. Yet the medical literature outside Jiangnan was neither copied nor listed in the imperial project. The collection of medical texts for the Ming and Qing periods in the *SKQS* hence did not give a representative sample of what had been written in the whole empire. On the contrary, it constituted a very selective sample of books.

If modern scientists resort to efficacy and rationality to legitimize their choice among a wide range of theories or practices available to them, what was the reasoning behind these selections? A definitive answer still requires work on the ways selections were made by the commission to rank the submitted medical books and on the content of the books that were finally selected for this prestigious compilation in comparison with the content of the books that were finally rejected. However a first glance at the authors who succeeded in having their titles selected by the *SKQS* commission argues for their proximity to Jiangnan elites and to the imperial power.

If Jiangnan had been an important economic and cultural center since the middle of the Tang dynasty, it became *un lieu de pouvoir* after the transfer of the capital to the Southern provinces of Zhejiang in the Southern Song dynasty (1127–1279) and Jiangsu during the first part of the Ming dynasty (1368–1409). By producing the highest number of successful examination candidates, Jiangnan filled the ranks of the empire's bureaucracy with its native scholars. Not surprisingly, many prominent scholars from Jiangnan served on the *SKQS* commission and, most likely, favored the texts submitted by Jiangnan officials who, in turn, clearly played patron for the authors of their region.[28]

As shown in Column 4 to Tables 1–4, 81 (or, 75%) of the 111 titles of Ming/Qing medical books either copied in the *SKQS* or listed in the *Annotated Catalogue*, were in fact submitted by Jiangnan elites: 73 by high officials and 8 by private donors such as Fan Mouzhu of the famous Tianyige library of

[28] (Elman [1984] 2001, 11; Hanson 1997, 213–214).

Hangzhou and Zhu Zunyi from Zhejiang. 11 titles were submitted by Zhong Yongnian, then Grand Councilor of Shandong province who, not surprisingly, promoted the texts by one physician of Shandong province. The others were either in current use (12), taken from the Imperial Household library (6) or given by the emperor himself (1).

The proximity of Jiangnan elites to political power should be taken into account when explaining the regional dominance of Jiangnan medical literature in the *Golden Mirror* and in the *SKQS*. However, these editorial projects did not promote regional voices for their own sake. Other motives lie behind these selections as well. In his analysis of the mathematical and astronomical section of the *SKQS*, Chu Pingyi, in this volume, highlights how editors equipped Chinese scholars with a tradition that could compete with the Western tradition. The collection of medical texts in the *SKQS* did not meet this agenda. Even if the intellectual motives that lay behind these selections still need further systematic research, the initial analyses led by M. Hanson show that the editors put the emphasis on a trend of scholarship which had its roots in the mid fifteenth century but later developed in a more systematic manner and was dominant in Jiangnan. This tradition was characterized by an emphasis on ancient classical learning and by using methods that stressed exacting research and rigorous analysis in order to recapture the "true meanings" formulated by the sages of antiquity in the original Classics that later interpretations, particularly those of Song scholars, were accused of having perverted. Because texts from the Han dynasty were considered the most reliable knowledge, this movement was called Han learning *(Hanxue* 汉学, Han studies) in the early seventeenth century. The movement later came to be called evidential scholarship (*kaozheng* 考证*: lit*. "search for evidence") in the eighteenth century in relation to the scholars' attempts at reconstructing Han texts, using extensively philological exegesis, historical analysis and textual criticism.[29] For Hanson, imperial compilations undertaken in the eighteenth century gradually imposed the medical culture of the physicians who had applied the evidential methods of textual scholarship to medical sources of the Han dynasty.[30]

Like the compilation as a whole, the collection of medical books in the *SKQS* was thus biased toward texts produced in the richest and most powerful region. Furthermore, these texts were produced in close association with the high officials of the time who served as patrons for the *SKQS* commission.[31] We assume that, conversely, books written in less powerful circles might have been deemed not worthy of being read. Indeed, such is the case of books from the extreme south of China. In 1772, the Governor Li Hu wrote that it was not necessary to establish a single book bureau in Yunnan.[32] In fact, and in spite of

[29] On this intellectual trend, see (Elman [1984] 2001; Guy 1987).

[30] (Hanson 2003).

[31] (Elman [1984] 2001, 102).

[32] (Guy 1987, 88, note 64).

the existence of books in this province, no book from Yunnan was submitted to the commission. The same prejudices very likely occurred for the province of Guangxi from where no books were submitted either.[33]

The lesser level of integration of far south elites in the political center might have been one reason why no element of cultural production from the far south was submitted to the *SKQS*. Moreover, this area, in the mind of the Chinese gentry, contained both ecological and ethnic defects. The climate there was too humid, *yin* 阴, and was often held responsible for the existence of "miasmas," *zhang* 瘴, that non native people could not survive.[34] Moreover, numerous aborigines, i.e non Han people, were known to live there and these people challenged not only imperial authority but also Confucian standards of human conduct.[35] These tribes, therefore, did not represent merely a military threat for the Chinese empire, they were also a cultural threat that "civilizing" missions, launched at different times in history and targeted at "moral transformation", tried to eradicate. As W.T. Rowe stated, the ambitious project of establishing Confucian schools in Yunnan, undertaken at the beginning of the eighteenth century, still reflected the Han elites' fear that the Chinese had acculturated to aboriginal life and that boundaries between Han and non Han ethnics groups and between elite and popular cultures had eroded.[36] In this context, it is likely that the Chinese elites involved in the imperial editorial project of the *SKQS*, drawn mostly from Jiangnan, deemed that nothing in the literature of the far south merited consideration for inclusion in the orthodox corpus.

The Selective Promotion of Medical Texts and Its Impact on the Historiography of Medicine

The different considerations of the imperial editorial team towards documents had an impact on the material and social life of documents. Firstly, all texts did not have the same chances of survival. The texts that were copied or listed in imperial compilations had a better chance of surviving and falling in the hands of modern historians than the texts that were not included in these compilations. This holds true for ancient and medieval manuscripts, as K. Chemla stresses in her contribution, and also for texts written much later. Imperial compilations are in fact repositories of texts that have not otherwise survived.[37] Documents not included in imperial publications have stood a greater chance of disappearing. Secondly, like the Latin *florilege* in medieval and modern Europe,[38]

[33] (Guy 1987, 90).
[34] For reference of "miasmas" *zhang* in historical sources, see (Li Yaonan 1954).
[35] See (Diamond 1991, 1994).
[36] (Rowe 1994, 423).
[37] (Drège 2007, 31; Diény 1991).
[38] (Blair, 2007).

such imperial compilations served to draw readers' attention to a selection of authors and, in this process, contributed to the historical promotion of some texts that were thus turned into texts of high value, either for the contemporaries of these imperial projects or for later historians.[39]

By favoring the currents of medical thought and standards of scholarship dominant in Jiangnan, the *SKQS* as well as the earlier *Golden Mirror* contributed to the promotion of the texts that originated in this area and thus to the marginalization of the rest of the medical literature that acquired secondary status. The latter was never included in any historiography. The official history of the Qing dynasty, written between 1914 and 1927 according to a long-standing Chinese tradition which obliged the newly-established regime to make an official history of the previous overthrown dynasty, counting 26 biographies of physicians from Jiangnan out of a total of 37, continued to place Jiangnan medicine at the center of the medical tradition while ignoring what had been thought and written elsewhere.[40] But these works were also overlooked in non-official historiography. To summarize, if the scholars of the seventeenth and eighteenth centuries, by their attempts to reconstruct ancient sources, established the foundations for our knowledge of ancient China as B. Elman states, we wonder whether they did not also condition our knowledge of late imperial China, drawing our attention to a small sample of authors and texts.[41]

The example of these imperial compilations shows that even though Jiangnan was highly active in the production of medical texts and medical culture, the contributions of this area were emphasized by powerful Jiangnan elites who succeeded in promoting the voices of their region in the eighteenth century. The objective of this present contribution is not to deny the importance of Jiangnan medicine in Chinese history. Rather, being well-aware of the possible impulses and conditions that may have contributed to a historical promotion of the medical literature produced in this area, we ought to question what would change if we were to listen to the voices that did not benefit from the same support. Would the social and cultural landscape of medicine in late imperial China shaped by a historiography focused on Jiangnan change? Would the centrality of Jiangnan medicine fade away, to apply David Faure's predictions on the historiography of medicine? [42]

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[39] Even if we cannot explain how this happened, we are obliged to note that Ming and Qing texts selected in the *SKQS* have been given prominence in the historiography of medicine in late imperial China.

[40] (Zhao Erxun [1928]1998, 3548–53).

[41] (Elman [1984] 2001, 4).

[42] (www.cckf.org.tw/PrincetonWorkshop/papers.htm).

The Reintroduction of Some Texts Produced Outside Jiangnan into the Historiography of Medicine: What Does This Change?

Let us, therefore, turn our attention to another region of the Chinese empire – the far south, which as mentioned earlier was usually held in contempt by Chinese elites – and to its medical landscape. Note that any other region beyond Jiangnan and the capital, which were perceived and constructed as the cultural centers of the empire, may be eligible to direct one's attention for answering these questions.

Before seeing how the reintroduction of neglected sources in the historiography of medicine would change our knowledge of medicine in late imperial China, or, at least would open new perspectives for the history of medicine, the medical texts produced in this specific area first had to be identified. Local gazetteers, and specifically their bibliographic and biographic sections, allow us to take a census, certainly in a not exhaustive but in a matchless way, of texts written in a specific geographic area. This census gives, at first, an idea of the amount of the medical literature written locally. It also gives an insight into the social composition of this community of medical writers.

An Expansion of the Community of Medical Writers and Medical Practitioners

From a huge number of historical sources, including local gazetteers, Guo Aichun and his team have identified 181 authors and I have identified four more authors in the provinces of Yunnan, Guangxi and Guangdong in the last dynasty. As Table 5 shows, local gazetteers from this part of China reveal a growing community of medical writers in late imperial times: 185 authors and 276 texts are recorded for the Qing dynasty, while 25 authors and 35 medical texts were recorded for the Ming dynasty. This change represents a sevenfold increase in both books and authors in the area. Just as in Jiangnan, and more generally in the rest of the empire, the community of medical writers in the far south increased in number during the last dynasty.[43]

In fact, medical writers sprouted up from a community of experts in medicine that likewise increased. As Table 6 stresses, local gazetteers from this part of China provide statistical support for the picture of a growing number of experts in medicine, that is of healers who, in conformity with the ideals of the scholarly elites, used medicine (*jing yu yi* 精于医, *jing Qi Huang shu* 精岐黄术, *tong yixue* 通医学 etc.) and not shamanism or religious arts. I shall call them "medical practitioners" or "medical experts" instead of "physicians" to better match the different social realities lying behind these Chinese formulations. The 167 biographies which have chronological markers (from a wider corpus of 422 biographies

[43] Local gazetteers provide evidence that this phenomenon took place everywhere in the empire: 5,153 book titles had been recorded in all parts of the Qing empire as opposed to a total of 2,048 before it. See (Hanson 1997, 35 and 332, on the basis of Guo Aichun 1987).

analyzed) reveal that the number of medical practitioners in the far south of China increased 26-fold between the beginning of the eighteenth century and the end of the nineteenth century. Even if these figures cannot be taken as inclusive of all medical practitioners, the way physicians are recorded by a professional institution, they indicate a general trend of an increase in the number of medical practitioners in the region. The community of medical practitioners in the far south thus followed an evolution similar to those located in more urban and integrated parts of the empire, but with a short delay. In Suzhou, a prefecture of Jiangsu province and the heart of the Jiangnan region, the number of medical practitioners grew from three under the Tang, to five under the Yuan, to 88 under the Ming and to two hundred and nineteen under the Qing.[44]

In the case of the Jiangnan region, the growing interest in medicine during late imperial times has been explained by the combination of important changes in the social, economic and cultural fields that took place in the early sixteenth century. The huge growth in the population was at the origin of these changes. Most notably, this growth disrupted the social components of the late imperial society, giving rise to the emergence of a wealthy merchant class. As the status of merchants had long been denigrated in Chinese history, the merchant class sought a more respectable status and devoted themselves in particular to providing their descendents with the education necessary to enter government service. At the same time, the opportunities which offered the possibilities of attaining the most respected positions had dramatically reduced. By devoting their life to relieving the suffering of their kin and the populace, they chose one of the most respected alternatives to government service, since the Song (960–1279), as had been formulated by the Song scholar Fan Zhongyan: "if one does not become a good official, then one should become a good physician".[45] In the process of curing diseases, the medical expert could practice the Confucian virtues of filial piety, benevolence and even charity, just like the statesman governing the country. As J. Grant writes, "for merchants trying to climb the social ladder, although a bureaucratic career was preferable, being a physician was a good second best in terms of respectability and status."[46] As a matter of fact, the community of medical practitioners increased in Jiangnan.

This explanation also holds true for the far south of China. Undoubtedly, the three provinces under discussion here offer sharp contrasts. Yunnan and the western part of Guangxi were among the remotest areas of the Qing empire. By contrast, the province of Guangdong, which included Guangzhou, one of China's largest cities and seat of the monopoly of overseas trade after 1757, had experienced a rapid development in its urban structure since medieval periods. This province was, moreover, well integrated with the rest of the empire. By Northern Song times, the major north-south road ended there. Although Guangdong and the eastern part of Guangxi were interrelated thanks to a network of navigable rivers,

[44] (Chao Yuan-ling 1995)

[45] (Hymes 1987)

[46] (Grant 2003, 32).

constituting, in Skinner's words, "one physiographic unit" which the Chinese once called Lingnan (South of the mountains), no rivers in Yunnan were navigable and all official and commercial transport had to be done by land. As a result, Lingnan, whose population had risen from 15 to 28 million people between the beginning and the end of the eighteenth century, was, by the end of the nineteenth century, highly urbanized.[47] Moreover, its urban structure was more integrated with the empire than the urban system of Yunnan. By the end of the empire, the macro-region of Yungui (composed of the provinces of Yunnan and Guizhou) was among the least urbanized regions of China, comprising small and tenuously interrelated cities.[48] However, if transportation difficulties delayed urbanization and economic development in Yunnan, this province also experienced an economic boom and an increase in population during the Qing dynasty. The development of copper mines and the improvement of roads were actively supported by the government and led to consistent immigration in this province. By the beginning of the eighteenth century, these advances resulted in dramatic population growth: from 1625 to 1850, the population increased fivefold. Although before 1750 Yunnan province had the lowest urban to rural proportion for any region in China, by 1830 the urbanized population increased in number here too.[49]

The combination of important social and economic changes which led to the growth in the community of medical experts at Jiangnan also occurred in the far south of China. These changes might have been at the origin of the increase in the number of medical practitioners here too. A glance at the geographical breakdown of my collection of biographies reveals that medical practitioners mainly congregated in the provincial capitals and major urban centers such as Guangzhou, Yunnanfou (present day Kunming), Guilin and sub-prefectures along the commercial routes between Guangxi and Guangdong while few or no medical practitioners were known in the sub-prefectures of the southwestern part of Yunnan or the sub-prefectures of the western part of Guangxi.[50] Furthermore, the analysis of the biographies shows that in the far south also, the practice of medicine was often a second choice career after successive failures in the civil service examinations: among this sample of medical practitioners, 7% first failed the civil service examinations and 34% obtained one degree, albeit in most cases the lowest. Hence, in the far south of China, as in Jiangnan, turning to medicine was often a second-rank alternative to a public career. However, a career in medicine could be also a step upward, though less so for merchants, as seems to have been the case in Jiangnan, than for people born into poverty, particularly

[47] (Marks 1991).

[48] (Skinner 1977, 11, 227, 228, 241).

[49] (Lee 1982a, 718, 722, 723). According to (Lee 1982b and Marks 1991), the rate of urban population for Yunnan in 1830 reaches 10%, while for Skinner, this rate was of 4% only. According to (Bin Yan 2008, 230), Lee and Marks' rate of urbanization (10%) is a more reliable figure obtained by paying a closer attention to cross-regional connections between Yunnan and Southeast Asia, to commercialization, and immigration.

[50] (Bretelle-Establet 2002, 71).

young orphans who had to support their family.[51] Therefore, if medicine did not provide as a high status as government service, it did allow people of lower strata to climb the ladder of respectability, to emerge from the obscurity of the common populace, to merit a biography, and perhaps to have a bibliography recorded in official sources, side by side with the highest local officials.

In fact, as noted previously, the practice of medicine in the far south entailed not only treating people but for an increasing number of medical practitioners it also involved the writing of medical texts. As Table 5 stresses, writers were more numerous in the coastal and urbanized province of Guangdong than in the other two provinces. Then, writing a medical text constituted a cultural activity highly related with the status of the medical practitioner. As Table 7 shows, a higher percentage of medical experts who had obtained an imperial degree wrote medical texts than medical experts who had no imperial degree. It does not mean that authors were all degree holders and thus qualified for government service. In fact, the majority of the medical writers (109 out of 185, or 59%) in the area had no degree.

This brief survey of the size, the development and the social features of the community of the medical writers in the far south of China shows that medical texts were produced from varied social circles. It is likely that these medical authors, belonging to different social milieus, involved in the practice of medicine to different extents – some were private teachers or official bureaucrats while others practiced medicine as a sole occupation – , trained or not in the Classics, used different formats of writing and answered to diverse needs. By focusing on the titles of books alone, I have shown elsewhere that people did not write on the same subjects if their sole job was the practice of medicine or if they served in the bureaucracy and occasionally provided medical assistance. If bureaucrats usually wrote books of formulas (fangshu 方书) and general treatises, people involved solely in the practice of medicine often chose to write books of medical case histories (*yi'an* 医案).[52]

The extant literature should throw light on the motives that led medical practitioners, who thus belonged to different social milieus and lived in the hinterland or the heartland, to write medical texts and to choose specific formats. It should also give an insight into their cultural background and their ways of dealing with diseases. However, before considering these issues, let us first try to understand the conditions under which medical texts came to be preserved and handed down.

How Did Books Come to Be Preserved?

Amazingly, of the 276 titles recorded in historical sources, only 33 texts still exist in Chinese libraries today (see Table 8) according to the *Catalogue of Medical*

[51] (Bretelle-Establet 2002, 87–8).
[52] (Bretelle-Establet 2002, 93–105).

Books in Chinese Libraries.[53] Several factors may explain why so few writings have survived. As mentioned earlier, none of these texts were copied in imperial compilations such as the *SKQS*, which played a crucial role in the preservation of texts. In fact, many of these texts did not even reach the stage of printing. Because of the acute competition between healers, as indicated by the increasing number of biographies of medical experts in the gazetteers, some authors probably preferred to pass their secrets to their sons. Even more likely, though, others could not afford to print their texts. As various prefaces record, authors had either to enroll subscribers or to rely on the patronage of a local official to have their books printed. In all cases, therefore, having one's book printed implied contact with influential local people, be they rich or members of official circles, contacts which the ordinary man rarely had. A great part of the medical literature thus remained in manuscript form. These texts were, therefore, vulnerable to threats from fire, flood, theft and wars, especially in the far south of China, which had been at the heart of intense rebellions in the nineteenth century.[54] Several prefaces and biographies describe the difficult conditions facing manuscripts. A preface to Chen Huangtang's 陈 焕堂 (mid-nineteenth century) book, *The Cold Damage Treatise Basic Truth* (*Shanghan lun guizhen* 伤寒论归真), recalls that for 10 years, Chen's manuscript weathered floods, fires and wars. Liang Lianfu's 梁廉夫 (1810–1894) preface to his *What the Ignorant in Medicine Should Know* (*Bu zhi yi biyao* 不知医必要) records that half of his manuscript had been destroyed because of wars. Zhou Qingyang's 周庆扬 (Qing, dates unknown) biography relates that his book *Excellent Formulas for Acute Diseases* (*Jizheng liangfang* 急症良方) had disappeared because of wars in the region. The bibliographic notice of Gong Pengshou 龚彭寿 (1862–1926) describes how his manuscript *Rough Medical Knowledge* (*Yixue cuzhi* 医学粗知) had first been stolen, then recopied from his first draft, and later largely destroyed by insects.[55]

We can also assume that the people in charge of assembling academic collections of medical books in the twentieth century did not collect all the extant medical texts but just selected some of them according to various criteria.[56] Whatever the reasons might be, related to ancient or modern selective

[53] Inquiries in libraries show that this catalogue's census is not entirely exact, though.

[54] In the second half of the nineteenth century, various revolts took place in the south of China. The Taiping rebellion began in the province of Guangxi in 1851 and officially ended in 1864, but local riots continued until the beginning of the 1870s. In the province of Yunnan, a rebellion between the Muslims and the Han people began in 1856 and ended in 1873. The province of Guangdong suffered from the 1854-1855 Red Turban uprising and from the French and British attacks from 1856 to 1860. Domestic rebellions and foreign occupation resulted in large destruction of facilities and books (Bretelle-Establet 2002, 16–20; Miles 2006, 171–4).

[55] See in this order (Chen Huangtang 1849, 1; Liang Lianfu [1881] 1936, 3; Guo Aichun 1987, 2030, 2033).

[56] The huge collections of Ming and Qing medical manuscripts formed by P. Unschuld in the last two or three decades reveal firstly that it has still been possible to find and to buy ancient medical manuscripts on the Chinese markets, in the last thirty years, and secondly that academic collections either by choice, ignorance or lack of money, have not preserved them.

processes, medical texts from the far south that have survived in today libraries are scarce. Moreover they are not representative of all the medical literature which was written in all the social circles. As Table 8 shows, firstly, the extant literature from these three provinces comes mostly from the coastal province of Guangdong. Secondly, 54% of the authors whose books have been preserved passed the civil service examination, the normal route for government service or bought an official function. This rate is a little bit higher than the percentage of such graduates (41%) among the population of medical writers in the far south. Therefore, the medical literature preserved in libraries represents, above all, the labors of a specific portion of the medical writers, essentially those in Guangdong and whose knowledge in the classics had been sanctioned by the state. Very often, these authors could benefit from the support of a local official who agreed to write a preface, increasing thereby the author's chances of being published.

When studying the motives behind the increasing textual production in this part of the empire and the cultural background of its authors, we, therefore, must content ourselves with what has survived, namely 33 texts and a few prefaces which, for reasons as yet unknown to me, were copied by local gazetteers and thus preserved.

What Did It Mean to Write Medical Texts in Remote, Rural or Urbanized Areas?

The correction of misinterpretations of ancient texts was one reason cited by some people in eighteenth and nineteenth centuries for the writing of new medical texts in the far south of China. Huang Zijian 黄子健, active in the second part of the eighteenth century in Nanhai (Guangdong) and holder of the first degree, presents himself as a specialist in Zhang Ji's books. His preface to his book *A Revision to the Collected Annotations on the Jinkui Canon* (*Dingzheng jinkui yuhan jing jizhu* 订正金匮玉函经集注) makes clear that he was familiar with the different stages the original manuscript *Treatise on Cold Damage Disorders* had passed through since its printing under the Song dynasty and that he was well-versed with all its commentaries. He stressed the importance of avoiding bad interpretations of the master Zhang Ji and agreed with most of the interpretations of the critical edition in the *Golden Mirror on the Orthodox Medical Lineage*, an element of the philological trend then prevalent in Jiangnan. Huang Zijian intended his book to reveal the true meaning of Zhang Ji's doctrine and to restore the original order of Zhang Ji's book.[57] The above mentioned Chen Huangtang (ca. 1849), from Dongguan (Guangdong), also writes that his book aimed to recover and reveal the true meaning of Zhang Ji's books that would enable practitioners to treat their patients more efficiently:

[57] Huang Zijian's preface in (Guo Aichun 1987, 1934).

> Nowadays nobody dares to contradict [Zhang] Zhongjing... But if we look at how they cure cold-damage disorders and make their prescriptions, it is as if everyone has forgotten Zhongjing or as if their ways of doing are totally inconsistent with those of Zhongjing.[...] What a pity ! [...] Throughout my life, I have trusted in the book of Zhongjing. I read it very cautiously and I've thought about it very carefully, and thanks to this labor I have always obtained efficiency. Hence, to make sure that people don't misunderstand, I gathered together Zhang Zhongjing's techniques and wrote this book. Step by step, I explain and reject its misinterpretations, step by step, I disclose its content, I draw your attention to its obscurity and I draw your attention to its correct truth [...] we must turn back to his basic truth. If you know his basic truth, then you'll be able to help people and to be useful for people.[58]

Correcting misunderstandings of ancient texts is a recurrent motive in the history of medicine, invoked as early as the third century by Huang Fumi in his attempt to restore the *Yellow Emperor's Inner Canon*, (*Huangdi neijing suwen* 黄帝内经素問).[59] However, these authors paid particular attention to the medical texts produced in the Han dynasty and made it their goal to expunge them from later interpolations. It is, thus, very likely that these authors shared the fashionable concern of the Han Studies or Evidential scholarship. This scholarship, as already mentioned, had reached its zenith in eighteenth century Jiangnan, and was given prominence in the imperial editorial projects commissioned in that century. As Miles has recently shown, these scholarly and literary practices were widely disseminated in early nineteenth century Guangdong, through the establishment of the Xuehaitang Academy.[60]

The promotion of a particular way of thinking and curing disease was another rationale for some authors from the far south. He Mengyao 何梦瑶 (ca. 1693–1764, Nanhai, Guangdong), holder of the highest degree and of official positions, intended his book to be a textbook for beginners in medicine, as its title *Stepping-Stones for Medicine* (*Yibian* 医碥) indicates. His preface, however, makes it clear that his aim was also to dissuade people from blindly following fashionable theories. "Nowadays formulas from the *Complete book of Jingyue* (*Jingyue quanshu*, 1624) are very fashionable...The heat of cinnamon and aconite is extremely burning, (and by using them) you just make a lot of people astonished." This motivation was also shared by Wang Xueyuan 王学渊 about whom we have no biographical information other than the fact that he was active in the middle of the nineteenth century in Maoming (Guangdong). Like He Mengyao, Wang Xueyuan intended his book *Principles for Heat-Summer Diseases* (*Shuzheng zhinan* 暑症指南) for beginners in medicine but his preface reveals that his secondary purpose was to correct a common misunderstanding of these diseases and to promote Ye Gui 叶 桂 (1667–1746)'s ideas.[61]

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[58] (Chen Huangtang 1849, 1–2).
[59] (Unschuld 2003, 22).
[60] (Miles 2006).
[61] (He Mengyao [1751] 1994, 47–8, Wang Xueyuan 1843, preface).

The creation of textbooks for pupils or useful compendiums for family use was a further reason that led medical practitioners to write medical books. Huang Yan 黄岩 (ca. 1751–1830, Guangdong), who taught medicine and had contact with local elites, wrote in his introduction of his *Essentials of Medicine* (*Yixue jingyao* 医学精要): "This book has been composed for teaching". Liang Lianfu (1810–1894, Guangxi) wrote his book *What the Ignorant in Medicine should know* (*Bu zhi yi biyao* 不知医必要) in order to help people self-medicate and avoid quacks' mistakes.[62]

Finally, some books clearly intended to update medical knowledge in order to solve emerging problems in public health. Such was the case of the *Excellent Formulas against Sudden Disorders* (*Huoluan lianfang* 霍乱良方) by Lin Xianfu 林贤辅 (ca. 1888, Guangdong) and the *Overview of the Forbidden Things in Case of White Throat Disease* (*Baihou jibiao juewei* 白喉忌表抉微) by Feng Xinlan 冯心兰 and Liang Yuanfu 梁元辅 (mid nineteenth century, Guangxi and Guangdong respectively):

> "These last years, dangerous cases of Sudden Disorders *huoluan* 霍乱 occurred nearly every year, it was very difficult! . . . hence I gathered all the working formulas that the Ancients had discovered, [. . .] and I wrote this book in order to facilitate their review".[63]

And,

> White Throat disease *Baihou* 白喉 is a type of hot disease. It is very dangerous and it advances very quickly. Furthermore, it is highly contagious. It was widespread in the northern provinces, and recently it has been introduced into the south. Physicians had not studied it previously. When they suddenly encountered this disease, they were ineffective. I was really sad because of this. Last year, I found the book *Baihou jibiao juewei* by the scholar Feng Xinlan of Guilin [. . .] It is the secret key to curing this disease effectively. I kept it very safely until I remembered that my nephew had been studying medicine for a long time. I sent it to him for making corrections, keeping the best of it and publishing it quickly, so that it spreads widely and that clinicians don't make errors anymore.[64]

The *Overview on Vaccination* (*yindou lüe* 引痘略, 1817) written by Qiu Xi 邱熺 is another example of a book written to update healing strategies against smallpox and to introduce the western techniques of vaccination:

> If I am the only one who has learned it, it will not be enough to go to the frontiers of the country nor enough to reach remote countries and we will contract smallpox everywhere. As for this method, I am the first one to have learned it and practiced it without mistake. I make this book about it and I offer it as a gift for posterity.[65]

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[62] (Huang Yan [1800] 1914, P. 1, Liang Lianfu [1881] 1936, 3).

[63] Lin Xianfu's preface (1888) in (Guo Aichun 1987, 1939).

[64] Liang Yuanfu's preface (ca. 1859) to Feng Xinlan's *Baihou Jibiao Juewei* 白喉忌表抉薇 in (Guo Aichun 1987, 1985). In fact, who was the original author of this book is still unclear to me.

[65] (Qiu Xi's preface [1817] 1864, 24).

Generally speaking, the collection of a medical expert's clinical cases (*yi'an)* in one book was often intended to update or adapt medical truths.[66] In fact, although some authors claim that they made it their goal not to introduce personal formulas when good ones already existed,[67] or that they did not dare to add their point of view,[68] or that they simply copied the best of ancient books,[69] other authors spell out the importance of improving ancient theories with their experiences in order to justify the presentation of their own clinical cases. Instances of this approach include Pan Mingxiong 潘明熊 (1807–1886, Guangdong) who reorganized the medical cases of the above mentioned Ye Gui yet included his own medical cases[70] and Zhan Ruiyun 詹瑞云 (post 1808, Guangdong) who noted that despite having read many books, he had also acquired good experience and knowledge of diseases though his own clinical activity. He thus decided to include his clinical cases in his book.[71]

In fact, at first glance, the motives behind the production of medical texts in the hinterland were similar to the reasons stated by medical authors of the heartland. The creation of textbooks for a diverse educated elite in search of a livelihood, the promotion of one's own theories and practices in the context of competition between an increasing number of medical practitioners, and the correction of misinterpretations of the classics according to the cultural context of Han studies and evidential scholarship were likewise goals that had contributed to the rich profusion of medical texts in the cultural centre of Jiangnan in late imperial times. However, if we consider the issue of who wrote what, we note that motives differed if authors lived in urbanized and integrated Guangdong or in rural and remote Guangxi and Yunnan. Notably, all authors who made it their goal to defend a correct interpretation of ancient texts or to promote the best conceptual framework for understanding and curing diseases originated from the coastal province of Guangdong. The extant literature and prefaces to medical texts produced in Guangxi or Yunnan never express this intention. As mentioned earlier, the extant medical literature from these two provinces is too sparse to draw firm conclusions from and only general assumptions can be formulated at this stage. However, it is not unlikely that the motive of filtering out and advancing one idea from among diverse theories, as often stated by Guangdong authors, be related to the fact that books and theories were more easily available in an urban and well-integrated region than in hinterlands.

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[66] For (Mu Peng 2006), this genre allowed physicians to present their own synthesis of knowledge based essentially on subjective knowledge.

[67] (Huang Yuanji [1763] 1799, Fan Xian's preface).

[68] (Wang Xueyuan 1843, preface).

[69] See Jin Jinghua's preface in (Guo Aichun 1987, 1960).

[70] (Pan Mingxiong [1864] 1935, 3).

[71] Zhang Ruiyun's preface undated copied in (Guo Aichun 1987, 1963).

In fact, although the majority of the extant books describe the amount of medical texts available as "terrifying,"[72] three authors deplore the scarcity of medical books. All three of these authors were based in Guangxi.

Huang Yuanji 黄元基 (ca. 1700–1778), holder of the medium degree and of official positions in the province of Guangxi, decided to write a book of formulas *Mature Formulas of Jingyun's Office* (*Jingyun zhai ji yanfang* 静耘斋集验方) because he had noticed that some places in Guangxi were isolated, poor, and lacked medical experts: "Even if erudite scholars continuously follow each other, when they go to poor counties and to remote places of our great country, how could they really go everywhere?"[73]

Later on, Miao Fuzhao 缪福照 (middle of the nineteenth century) recalled in the preface to *New Formulas for Curing Poisonings* (*zhigu xinfang* 治蛊新方) the poor situation of some particular places in Guangxi and the reasons why he had spent a few years correcting and editing a manuscript he had found by chance:

> Between 1825 and 1826, I was invited in a port town in the high mountains in the county of Bobai.[74] This town is between marshland and mountains. A great number of the inhabitants of the place were suffering from poison *gu*. There, the fields were not cultivated, and physicians and remedies were very rare. Deep inside myself I was sad. I delivered some prescriptions following the formulas (of the *Zhigu xinfang*) and all of them worked. Then, I took this book and got familiar with it. I improved it and corrected its errors. I sent it to a friend of mine that he might transmit it widely. Today, I am tired and have returned back home. In my native land[75], I am happy and quiet. Here people are wealthy and resources abundant, not like in those calamitous poisonous areas. Nonetheless, I can remember all the people who asked for help and bowed down on the ground. It is as if they are still before my eyes. I can remember how these people suffered. This increased my sadness and my sorrow. This is why I revised the book again and wrote this preface.[76]

We find this argument repeated by two gazetteers from Guangxi, edited as late as the 1930s: "In the villages of our county,[. . .], towns are very far from each other, and physicians are very rare. It is not propitious. Here are some formulas which have been gathered without any special order, and among them some concern poisonous injuries".[77]

Undoubtedly, books were more accessible in the late eighteenth century China than before. However, as McDermott has recently stated, the problems surrounding access to books, even in heartland areas, were not yet completely solved in the nineteenth century.[78] W.T. Rowe gives evidence that this problem was particularly

[72] (He Mengyao 1873, 1).

[73] (Huang Yuanji [1763] 1799, 1).

[74] A county in Wuzhou, in the Southeast of Guangxi.

[75] Miao Fuzhao was from Jiangyin, a sub-prefecture of Jiangsu.

[76] (Miao Fuzhao [1835] 1935, 1).

[77] (*Sanjiang xianzhi (Gazetteer of Sanjiang)* 1946, 728; *Rong xianzhi (Gazetteer of Rong)* 1936, 375)

[78] On this issue, see (McDermott 2006, Chapter 4 and 5).

acute in remote areas such as Yunnan. At the beginning of the eighteenth century, the high official in charge of the wide imperial project of establishing Confucian schools in the province of Yunnan, Chen Hongmou, recalled that he had regularly faced shortages of books and had been obliged to contribute his funds to import, reprint and distribute texts in the province.[79] The preface to the *Diagnostic of Leprosy* (*Fengmen bianzheng* 疯门辨症) written by authors who lived in Fujian province at the end of the nineteenth century (one of whom might have been the descendant of a Guangdong medical practitioner) offers another example of such a statement. After recalling that only one book – the *Complete Book on Leprosy* (*fengmen quanshu* 疯门全书) – had been written on the subject because of the general disgust the disease provoked among scholars trained in medicine, the authors explained that by the end of the nineteenth century, in 1877, this book was not even available in a provincial capital: "In Fuzhou, the provincial capital, not even one printed exemplar was available. One or two families had copied it and kept it in secret, but they did not want to show it to other people".[80]

Hence, in remote areas that probably lacked basic books, it is likely that authors were not so much concerned with the philological debates that arose in Jiangnan or the coastal province of Guangdong. Rather, they intended their work to be practical in character, in confirmation of what Rowe had highlighted about classical knowledge. Rowe noted that in spite of the ascendancy of Han Learning scholarship elsewhere, the most ancient Confucian texts were not at the forefront in eighteenth century Yunnan. There, an explicitly didactic and practical culture prevailed that relied more on recent compilations than on the Four Books and the Five Classics.[81] For Yunnan and Guangxi medical practitioners, based far from important urban centers, the most important reason for writing a medical text seems to have been to fill an academic void. Unlike the texts produced in well-integrated urban centers that aimed, for the most part, to impose a certain technique or theory or interpretation, these books might well have striven to display in one handy book the widest possible range of theories and citations for cases when the original books were not easily accessible.

Widening the historiography of medicine in late imperial China to other areas than the political, economical, and urban center of Jiangnan introduces a wider diversity of actors and of medical texts. Further, these texts allow the deciphering of the medical culture in all these various milieus. They notably cast light on what medical practitioners in remote areas knew and how knowledge circulated throughout the empire at a time when neither licensing laws nor formal medical instruction had codified the practice of medicine.

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79 (Rowe 1994, 440).

80 (Zheng Fengshan & Hou Jing'an [1877?] 1936, 87). The date of the first edition of this book remains unclear. For (Xue Qinglu 1991, 561), it is 1796 like the *Fengmen quanshu*. However, it is probably a mistake, since the authorial prefaces of this book were written in 1877. 1877 is thus probably the date of the first edition.

81 (Rowe 1994).

Which Medical Culture? The Different Competing Currents of thought

The cultural landscape of medicine in the far south can be outlined quite precisely in cases where local books have survived. When books are no longer extant, as is the case for the majority of the medical texts from Yunnan and Guangxi, we must rely on authorial prefaces or biographies, both handed down via gazetteers, to glean some insight into the medical cultural landscape in these provinces.

Without entering into the detail of each text which gives evidence of a specific cultural lineage (see Fig. 1), let us just briefly say that the general landscape reveals that divergent currents of thought originating outside the region, and notably from Jiangnan, were mentioned in Guangdong, Guangxi, and, to a lesser extent, in Yunnan. We find supporters of Zhang Jiebin's doctrine and his particular therapeutics in eighteenth century Guangdong and Guangxi. Zhang Jiebin (张介宾 1563–1640), active in Jiangnan (Zhejiang province), argued that the *Yang* component in the organism held primary importance and, therefore, advocated constant replenishment of the body with *Yang* influences to treat and prevent illnesses. He used mainly warming and tonifying drugs and was later classified as a representative of the "Warming and Tonifying School" *(wenbu xuepai* 温补学派*)*.[82] Liu Yuan 留渊, a Guangdong physician active around 1740, holder of the lowest degree and the Guangxi physician Yu Tingju 俞廷举 (ca. 1780), holder of the medium degree and official positions, were both adepts of this master's doctrine.[83]

However, although Zhang Jiebin's doctrine seems to have been popular at the time, particularly in the province of Guangdong, this physician's ideas and therapeutics also found strong opponents. The already mentioned He Mengyao and Guo Zhi 郭治, both active in the second part of the eighteenth century Guangdong, favored the medical doctrine of Liu Hejian 刘河间 (1120–1200) and Zhu Danxi 朱丹溪 (1281–1358) and strongly castigated the followers of Zhang Jiebin. He Mengyao, in his book preface, openly and rudely criticized his counterparts of "blindly" following Zhang Jiebin's ideas and the medical fashion that consisted in warming and tonifying. He warmly praised his friend, Guo Zhi, for distinguishing himself from the others who, being "confused", continued to follow Zhang Jiebin's theories. In addition to supporting the ideas of the two masters of the twelfth and thirteenth centuries, He Mengyao was an adept of Wang Kentang (王肯堂 1552–1632), a Jiangsu physician and thus contemporary of Zhang Jiebin, who was reported to be very popular in the eighteenth century.[84]

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[82] (Chen Dashun 1985, 125–33).

[83] See (Liu Yuan [1739] 1873, Wang Shu's preface and Yu Tingju [1780] 1991, 282).

[84] See (Guo Zhi [1753] 1981, 1–2 and He Mengyao [1751] 1994, 47–8, 52–3).

During the nineteenth century in the far south, we also find adepts of a trend of thought which developed in seventeenth century Jiangnan, after a series of severe epidemics broke out there. Observing that therapeutics formulated in ancient canons, particularly the *Treatise on Cold Damage Disorders* of Zhang Ji, were ineffective, a number of physicians residing in Jiangnan pinpointed deficiencies in these ancient canons and challenged previous assumptions about epidemics. Wu Youxing 吴有性, a Jiangnan (Suzhou) physician and contemporary of Zhang Jiebin and Wang Kentang, was an important actor in this movement. His *Treatise on Epidemics* (*Wenyi lun* 瘟疫论 1642) was the first to criticize ancient beliefs about epidemics. This treatise challenged the dominant, orthodox explanations of epidemics received from the *Treatise on Cold Damage Disorders*. Following in Wu Youxing's footsteps, an increasing number of physicians in eighteenth and nineteenth century Jiangnan expressed their skepticism of the cold-damage tradition and opened the way for a re-evaluation of ancient medical beliefs. In particular, they argued that warm-factor diseases – which had been considered a subcategory of the cold-damage diseases according to the cold-damage tradition – were, in fact, distinct diseases. They also argued that people in the South were more affected by warm-factor diseases than by cold-damage diseases. These authors were later referred to as representatives of the Warm Factor Disorders School (*wenbing xuepai* 温病学派).[85] The Guangdong physician Wang Xueyuan, active around the middle of the nineteenth century, was an adept of this new trend in scholarship and particularly praised the theories of Ye Gui 叶桂 (1667–1746), identified, in Wang's day, as one of the most important representatives of this current of thought. Another Guangdong physician, Pan Mingxiong 番明熊 (1807–1886), presented himself as an opponent to Zhang Jiebin and compared Ye Gui's knowledge to a candle that brings light to an obscure room.[86] Source material provides evidence that the dispute which emerged in Jiangnan about the proper way to treat epidemic diseases was known even in remote Longling in the western part of Yunnan, on the frontier with Myanmar. The son of Zhao Zhibeng 赵之琫, probably active in late eighteenth century Longling, a place reported to be particularly unhealthy and "miasmatic" *zhang*, recorded that his father had read the *Treatise on Epidemics* by Wu Youxing and is reported to have said: "I don't know if the cold-damage disease (*shanghan* 伤寒) and the epidemic disease (*wenyi* 瘟疫)are the same, but what I surely know is that epidemic diseases and 'miasmas' (z*hangqi* 瘴气) are one and only one disease".[87]

Although other Jiangnan authors, known for their skepticism of the ancient canons and their praise for adapting ancient truths to local situations and bodies, were also cited by nineteenth century Guangdong physicians, we

[85] On the history of the construction of this scholarship, see (Hanson 1997).

[86] See (Wang Xueyuan 1843, preface) and (Pan Mingxiong [1864] 1935, 1–4).

[87] Zhao Jingsheng's note in (*Longling xianzhi* 1917, 537–9).

find opponents to this trend of scholarship as well. A number of physicians in the far south still proclaimed themselves adherents of the cold-damage tradition. The above mentioned Chen Huangtang (active around 1840) criticized the view that Southern people differed physiologically from the Northerners and, therefore, were not affected by cold-damage diseases *shanghan* but were more inclined to contracting other diseases. This point of view, Chen noted, was recent and absurd and Chen did not hesitate to dismiss those who followed such an idea as quacks: "These days people ceaselessly repeat that in the South (people) have no cold-damage disorders. It is just because they are quacks."[88]

Finally, another current of thought was emerging in the far south during the nineteenth century: it brought together those who promoted western medicine and especially the western technique of vaccination, such as Qiu Xi, a physician from Guangdong and one of the earliest Chinese who had learned cowpox vaccination and had written a book on the technique.[89]

Reintroducing the medical documents which were produced in the far south of the empire into the historiography of medicine allows us to observe that the competition between the different currents of thought active in important centers such as Jiangnan also had ramifications for the medical landscape of the far south.[90] Adepts of Han Learning and of Evidential Research tried to recapture and uncover the "true meaning" of books from the Han dynasty. In doing so, they favored the cold-damage tradition and, at times, contended with medical experts who had turn their back on these ancient truths. At the same time, Western medicine and vaccination in particular, also had its adepts. Knowledge thus circulated from heartland areas such as Jiangnan to other places, located in the hinterland such as Guiping in Guangxi or Dongchuan in Yunnan. By which channels it passed and how long it took for new ideas and doctrines to reach remote areas remains to be briefly discussed.

Channels of Transmission

The analysis of the extant literature and biographies of individuals from this part of China sheds light on the different channels by which knowledge reached the remote parts of the empire.

Firstly, though the central institution, the Imperial Bureau of Medicine *Taiyi yuan*, with its examination system and its medical reference books, did not train far south physicians directly, its by-products (namely, the imperial editorial projects mentioned earlier) were influential in homogenizing medical knowledge. The *Golden Mirror*, which had been adopted by the imperial medical

[88] (Chen Huangtang 1849, 15).
[89] (Qiu Xi [1817] 1864).
[90] On this competition in Jiangnan, see (Grant 2003; Unschuld 1985; Hanson 1997).

institution as teaching material in 1749, had been in the hands of a small number of far south physicians. The medical part of the *SKQS* was, at the beginning of the nineteenth century, referred to by the Guangdong physician Jin Jinghua 金菁华 (ca. 1810). Not only did this man claim to have learned medicine by reading it but he also explained that he decided to write his book *Summary of Medicine* (*Yixue jiyao* 医学辑要) by relying on the medical texts gathered together in this compilation.[91] Even if only one author describes reading the *SKQS*, more authors probably had access to it. Since 1787, the government had allowed literati with appropriate credentials access to the copies of the *SKQS* housed in three libraries in Jiangnan and even extended copying privileges to these readers. According to several scholars, the body of texts included in the *SKQS* must have been known by every scholar after the beginning of the nineteenth century.[92]

Secondly, the mobility of the people involved in medicine must have favored the circulation of knowledge from cultural centers to the rest of the empire. As noted above, a significant number of medical practitioners and medical writers served as bureaucratic officials and they were obliged to move regularly from one province to another or from one county to another. The above mentioned He Mengyao, Miao Fuzhi, and Liang Lianfu were some typical cases of these officials, who, having one foot in the bureaucracy and the other in the medical assistance, bridged different geographical milieus. He Mengyao, a native of Guangdong, visited the capital in 1730. After he had passed the metropolitan examination, he occupied several functions in the provinces of Guangxi and Liaoning, before returning to his native province and devoting his life to practicing medicine and writing medical texts. Miao Fuzhi (ca. 1830) travelled across Hunan, Jiangxi, Fujian, Guangdong and Guangxi for 17 years at the beginning of the nineteenth century before editing a medical book. Liang Lianfu, a native of Guangxi, occupied governmental posts in various parts of the province during the nineteenth century and finally wrote a medical treatise.[93] Mobility was not limited to bureaucrats though. A great number of biographies provide evidence that the medical practitioners who were not engaged in government service also traveled throughout the empire. Yi Liangshan 易良山 left his native Dianbai in Guangdong for the capital at the end of the seventeenth century. There he met the physician Zhai Yuhua 翟玉华 (1587–1671) who then was working in the Imperial Bureau of Medicine. Zhai Yuhua gave Yi Liangshan one of his books, a practice that must have been common in the process of sharing knowledge.[94] Mobility was not only common for people based in Guangdong, as S. Miles has recently shown, but it also

[91] Jin Jinghua's preface in (Guo Aichun 1987, 1960–1).

[92] (McDermott 2006, 168–9).

[93] (Guo Aichun 1987, 1933, 2019, 2028).

[94] Information extracted from Yi Liangshan's biography in (Guo Aichun 1987, 1931, 1960 and He Shixi 1991, 2:32 and 3:172).

affected people residing in more remote areas. Medical experts from Yunnan and Guangxi could easily reach the province of Guangdong, a brilliant cultural center that emerged in the early nineteenth century, thanks to the development of new academies, printing houses, and where a book market had blossomed between 1820 and 1860.[95] But some of them also went far beyond the limits of Guangdong, and traveled to the capital and to other provinces. So, in addition to the important waves of Han immigration that the far south, and Yunnan, in particular, experienced in late imperial times, and that, very likely, favored the importation of knowledge from the outside, people from the far south also moved northward and eastward. Even if this point needs further analysis, we can assume that knowledge circulated along with the medical practitioners themselves.[96]

Finally, the extant literature provide evidence that local networks existed for bringing together people who shared a common point of view and these networks probably enabled the circulation of knowledge. He Mengyao wrote a preface to Guo Zhi's book because they both were opponents of the *Warming and Tonifying School*. The Guangxi physician Liang Lianfu wrote a preface to the medical book of Gong Zhenjia (龚振家 1836–1908), a physician from the same area.[97] In his preface, Yu Tingju wrote that he had learned medicine not only by reading ancient books but also thanks to the discussions he regularly had with Xie Luyuan 谢鹿圆, another physician.[98] In a context where access to books might still have been difficult, local networks of physicians and friends might have enabled newly acquired books to be shared.

How the doctrines, the ideas and the practices imported from other parts of the empire were used and reconfigured by the medical experts working in the far south is one of the many other questions raised by the reintroduction of these sources in the historiography of medicine in late imperial China. Much work is being done addressing this question and there is not space available in this volume for the analysis completed thus far.

Conclusion

The fundamental aim of this project has been to understand why, among a medical literature of a daunting size, texts from Jiangnan have been the sole source material chosen by historians to demonstrate what medicine was like in

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95 (Miles 2006).

96 For Ruth Rogaski (2004, 73), it is probably the mobility of people inside the empire in the nineteenth century that explained that a treatise written by a southern gentleman became a best-seller in north China in only a few decades after being written.

97 (Guo Aichun 1987, 2030).

98 (Yu Tingju [1784] 1991, 281).

late imperial China. This paper shows how beyond the historians, imperial rule and its closest associates played an important role in promoting medical literary production from Jiangnan. Through imperial editorial projects such as the *Golden Mirror* and the *SKQS* launched in the eighteenth century, imperial rule played a powerful role in establishing the medical culture of Jiangnan at the centre of Chinese medicine while marginalizing medical documents produced outside Jiangnan. This study also shows how these manipulations and selections of documents had an impact on historiography which mainly focused on the documents that in the past had been granted dominant status.

An initial analysis of the prefaces and contents of a sample of the medical books written outside Jiangnan reveals that the reintroduction of these sources in the historiography of medicine not only casts light on the social and cultural history of medicine in one locality of the empire other than Jiangnan but contributes to understanding the broader issue of whether and to what extent events in the powerful socio-economic centre of Jiangnan can be extended to the rest of the empire.

As shown in this paper, certain trends highlighted by historians in their analysis of the medical landscape of the powerful socio-economic centre of Jiangnan also hold true for the poorer hinterland areas. As in Jiangnan, the combination of social and economic changes lies at the origin of the expansion of the community of medical practitioners and of medical writers in the far south. As regards knowledge, some of the medical practitioners working in the far south seem to have relied on the illustrious men and forbearers sanctioned by the imperial state, most of whom, during late imperial times, hailed from Jiangnan. However, the overall picture also reveals several contrasts. These contrasts very likely were even greater if the extant literature was not so biased towards writers who had passed civil service exams and were often engaged in government service or at least willing to enter it and thus towards a medical literature that potentially carried the most orthodox ideas or doctrines of its time. The extant corpus of medical literature, even though biased, still includes texts written by a number of different authors, specialized in medicine or not, located in the rural or urban areas, involved only in medical assistance or in other jobs. Their medical production thus allows the very precise examination of how medical writers, who belonged to different geographical and social milieus, referred or not to an established corpus of medical knowledge, how they appropriated the knowledge of their forbearers and how they redefined it in the face of local specificities (Fig. 1).

Annexes

Table 1 Ming medical authors and books selected in the *SKQS*

Provinces	Authors	Books titles	Books submitted by	Books by province
Anhui	Fang Youzhi	伤寒论条辨	Household library	7
	Sun Yikui	赤水玄珠	Zhejiang Governor	
	Sun Yikui	医旨绪余	Zhejiang Governor	
	Jiang Guan	名医类案	Ordinary use	
	Wang Ji	针灸问对	Salt Com. Lianghuai	
	Wang Ji	外科理例	Salt Com. Lianghuai	
	Wang Ji	石山医案	Salt Com. Lianghuai	
Zhejiang	Lu Zhiyi	痎疟论疏	Zhejiang Governor	6
	Lu Zhiyi	本草乘雅半偈	Zhejiang Governor	
	Zhang Jiebin	类经	Household library	
	Zhang Jiebin	景岳全书	Ordinary use	
	Xu Yongcheng	玉机微义	Salt Com. Lianghuai	
	Dai Yuanli	推求师意	Zhejiang Governor	
Jiangsu	Wu Youxing	温疫论	Ordinary use	6
	Miao Xiyong	先醒斋医学广笔记	Finance president	
	Miao Xiyong	神农本经疏	Zhejiang Governor	
	Wang Kentang	证治准绳	Ordinary use	
	Xue Ji	薛氏医案	Ordinary use	
	Xu Qian	仁端录	Zhejiang Governor	
Hubei	Li Shizhen	本草纲目	Yu Minzhong	3
	Li Shizhen	奇经八脉考	Yu Minzhong	
	Li Shizhen	濒湖脉学	Yu Minzhong	
Henan	Zhu Su	普济方	Fan Mouzhu	1
Total		23		23

Table 2 Qing medical authors and books selected in the *SKQS*

Provinces	Authors	Books titles	Books submitted by	Books by province
Jiangsu	Xu Dachun	神农本草经百种录	Jiangsu governor	7
	Xu Dachun	伤寒类方	Jiangsu governor	
	Xu Dachun	兰台轨范	Jiangsu governor	
	Xu Dachun	医学源流论	Jiangsu governor	
	Wang Zijie	绛雪园古方选注	Zhejiang Governor	
	Zhang Zhuo	伤寒兼证析义	Zhejiang Governor	
	Zhang Deng	伤寒舌鉴	Zhejiang Governor	
Jiangxi	Yu Chang	尚论篇	Ordinary use	2
	Yu Chang	医门法律	Jiangxi Governor	
Zhejiang	Wei Zhixiu	续名医类案	Shao jintang, revisor	1
Anhui	Wu Qian	御纂医宗金鉴	Empereur Qianlong	1
Total		11		11

Table 3 Ming medical authors selected in the *annotated catalogue*

Province	Authors	Books by author	Books submitted by	Books by province
Zhejiang	Ma Shi	素问注证发微	Zhejiang Governor	17
	Zhang Shixian	图注难经	Zhejiang Governor	
	Zhang Shixian	图注脉诀	Zhejiang Governor	
	Zhou Wencai	医方选要	Salt Com. Lianghuai	
	Yu Tuan	医学正传	Fan Mouzhu	
	Mo Biao	万氏家抄济世良方	Salt Com. Lianghuai	
	Zhang Shiche	摄生众 妙方	Salt Com. Lianghuai	
	Zhang Shiche	急救良方	Salt Com. Lianghuai	
	Gao Shi	志斋医论	Fan Mouzhu	
	Feng Shike	上池杂说	Cheng Pufang revisor	
	Huang Fuzhong	伤寒指掌	Zhejiang Governor	
	Yang jizhou	针灸大全	Household library	
	Huang Chenghao	折肱漫录	Salt Com. Lianghuai	
	Dong Shuo	运气定论	Zhejiang Governor	
	Gao Wu	针灸聚英	Salt Com. Lianghuai	
	Gao Wu	针灸节要	Salt Com. Lianghuai	
	Sun Zhihong	简明医彀	Household library	
Anhui	Wang Ji	续素问抄	Salt Com. Lianghuai	8
	Wang Ji	运气易览	Salt Com. Lianghuai	
	Wang Ji	痘证理辨	Salt Com. Lianghuai	
	Wu Zhenglun	养生类要	Salt Com. Lianghuai	
	Fang Guang	丹溪心法附余	Household library	
	Dong Bing	避水集验要方	Zhejiang Governor	
	Sun Tailai	孙氏医案	Zhejiang Governor	
	Wu Mian	河间六书	Ordinary use	
Jiangsu	Ding Zan	素问抄补正	Zhejiang Governor	6
	Xue Kai	保婴摄要	Zhejiang Governor	
	Jiang Yi	药镜	Zhejiang Governor	
	Zhang Sanxi	医学六要	Zhejiang Governor	
	Li Zhongzi	删补颐生微论	Zhejiang Governor	
	Li Zhongzi	雷公炮制药性解	Ordinary use	
Unknown	Chen Hui	神应经	Zhu Yizun du Zhejiang	4
	Zhou Hong	卫生集	Salt Com. Lianghuai	
	Li Tangliu	心印绀珠经	Salt Com. Lianghuai	
	Liu Yingtai	鲁府秘方	Salt Com. Lianghuai	
Henan	Xu Yongxuan	袖珍小儿方	Fan Mouzhu	4
	Liu Yu	安老怀幼书	Zhu Yizun du Zhejiang	
	He Tang	医学管见	Ordinary use	
	Li Lian	医史	Fan Mouzhu	
Hubei	Liu Chun	伤寒治例	Ordinary use	2
	Liu Chun	杂病治例	Fan Mouzhu	
Fujian	Xiong Zongli	素问运气图括定局立成	Salt Com. Lianghuai	2
	Chen Shixian	经验良方	Ordinary use	
Shanxi	Wang Shixiang	医开	Fan Mouzhu	1
Shandong	Wang Huazhuo	晋门医品	Zhejiang Governor	1
Total of books				45

Table 4 Qing medical authors selected in the *annotated catalogue*

Province	Author	Books titles	Books submitted by	Books by province
Shandong	Huang Yuanyu	素问解	Zhou Yongnian, G. councilor	12
	Huang Yuanyu	灵枢悬解	Zhou Yongnian, G. councilor	
	Huang Yuanyu	难经悬解	Zhou Yongnian, G. councilor	
	Huang Yuanyu	伤寒悬解	Zhou Yongnian, G. councilor	
	Huang Yuanyu	伤寒说意	Zhou Yongnian, G. councilor	
	Huang Yuanyu	金匮悬解	Zhou Yongnian, G. councilor	
	Huang Yuanyu	长沙药解	Zhou Yongnian, G. councilor	
	Huang Yuanyu	四圣心源	Zhou Yongnian, G. councilor	
	Huang Yuanyu	四圣悬枢	Zhou Yongnian, G. councilor	
	Huang Yuanyu	素灵微蕴	Zhou Yongnian, G. councilor	
	Huang Yuanyu	玉楸药解	Zhou Yongnian, G. councilor	
	Li Wenduan	得心录	V.P. Ministry of War	
Jiangsu	Xu Dachun	难经经释	Jiangsu Governor	11
	Xu Dachun	医貫砭	Jiangsu Governor	
	Chen Zhi	证治大还	Zhejiang Governor	
	Ma Yuanyi	马师津梁	Zhejiang Governor	
	Zhang Lu	张氏医通	Zhejiang Governor	
	Zhang Lu	伤寒缵论	Zhejiang Governor	
	Zhang Lu	本经逢原	Zhejiang Governor	
	Zhang Lu	诊宗三 昧	Zhejiang Governor	
	Chen Shiduo	石室 秘箓	Ying Lian G. councilor	
	Chen Tong	释骨	Zhejiang Governor	
	Ye Gui	临证指南医案	Zhejiang Governor	
Zhejiang	Wu Zhiwang	济阴纲目	Ying Lian G. councilor	4
	Wang Qi	保生碎事	Ying Lian G. councilor	
	Wu Yiluo	成方切用	Zhejiang Governor	
	Wu Yiluo	伤寒分经	Zhejiang Governor	
Anhui	Duan Mujin	医学汇纂指南	Anhui Governor	3
	Zheng Chongguang	伤寒论条辨续注	Ying Lian G. councilor	
	Jiang Zhilan	医津筏	Ordinary use	
Jiangxi	Li Wenlai	李氏医鉴	Household library	2
	Huang Gongxiu	医学求真录总论	Jiangxi Governor	
Total of books				32

Table 5 Medical writers and medical texts in the far south in Ming and Qing dynasties (identified in a sample of a hundred gazetteers)

	Authors/books in Guangdong		Authors/books in Guangxi		Authors/books in Yunnan		Authors/ booksTotal	
1644–1911	106	160	43	65	36	51	185	276
1368–1644	17	23	0	0	8	12	25	35
Before	9		0		0		9	

Source: Guo Aichun 1987, 1922–1929, 2015–2017, 2229–2231; Guiping xianzhi 1920; Yangshan xianzhi 1938; Dali Xianzhi 1916; He Shixi 1991, 2:639

Table 6 Distribution of the sample of biographies according to location and time

	Medical practitioners in Guangdong	Medical practitioners in Guangxi	Medical practitioners in Yunnan	Total
1644–1723	3	0	2	5
1723–1796	14	5	13	32
1796–1911	66	33	31	130
Total	83	38	46	167

Sources: Bretelle-Establet 1999, 524–5. Of the 422 biographies, only 187 include chronological clues; 20 belong to the beginning of the Republic period (after 1911) and are therefore not taken into account here

Table 7 Degree holders among medical writers and medical practitioners

	Wrote medical texts	Did not write medical texts	Total
Medical practitioners who have an imperial degree	76 (54%)	66 (46%)	142
Medical practitioners without imperial degree	109 (39%)	171 (61%)	280
Total	185	237	422

It reads: Of the 142 medical practitioners who had an imperial degree, 76 (or, 54%) wrote medical texts; of the 280 who had no imperial degree, 109 (or, 39%) wrote medical texts (a statistically significant difference at a 1% level)

Table 8 Qing medical books recorded in Yunnan, Guangxi, and Guangdong's gazetteers and preserved in Chinese libraries

Author	Title	Date (ca.)	Provinces, subprefectures	Degrees
Chen Huantang 陈焕堂	Shanghan Lun Guizhen 伤寒论归真	1849	Guangdong, Dongguan	No
Gan Yongde 甘庸德	Yaoxing fu 药性赋	1908	Guangxi, Pingnan	No
Guo Zhi 郭治	- Mairu 脉如 - Shanghan lun 伤寒论	1753 1827	Guangdong, Nanhai	附贡生
He Mengyao 何梦瑶	- Douzhen jiyao痘疹辑要 - Lezhitang renzi xuzhi 了只堂人子须知 - Sanke jiyao 三科辑要 - Shanghan lun jinyan伤寒论近言 - Yibian医編	1775 1872 1751 1757 1751	Guangdong, Nanhai	进士
He Shuyi 何叔夷	Erke miyao 儿科秘要	1893	Guangdong, Dabu	No
Zheng Fengshan 郑风山	Fengmen Bianzheng 疯门辨症 Sizhen zuanyao 四诊簒要	1796	Guangdong, Xiting	诸生

Table 8 (continued)

Author	Title	Date (ca.)	Provinces, subprefectures	Degrees
Huang Weiyuan 黄炜元	Bianyi zhenji 辨疫真机	1914	Guangdong, Chaozhou	No
Huang Piaozhi 黄朴之	Xiaoyan Liangfang 效验良方	1933	Guangdong, pining	No
Huang Yan 黄岩	-Yanke zuanyao 眼科纂要 - Yixue jingyao 医学精要	1867 1800	Guangdong, Jiaying (meizhou)	No
Huang Yuanji 黄元基	Jingyun Zhai Jiyan Liangfang 静耘斋集验良方	1763	Guangxi, Guiling	举人
Li Xishun 李希舜	Jingyan liangfang 经验良方	1753	Yunnan, Zhaotong	举人
Liang Guoheng 梁国珩	Jiuyi quansheng Pian 救疫全生篇	1899	Guangdong, Nanhai	No
Liang Lianfu 梁廉夫	Bu zhi yi bi yao 不知医必要	1881	Guangxi, Guixian	科副贡
Lin Jielie 林介烈	Mazhen quanshu 麻疹全书	QL/ 1936	Guangdong, Jieyang	No
Liu Yuan 留渊	-Yixue zuanyao tangfang huofa 医学纂要汤方活法 -Yixue Zuanyao 医学纂要	1739 1739	Guangdong, Huizhou	武生
Lu Shunde 路顺德	Zhi gu xin fang 治蛊新方	1835	Guangxi, Rongxian	举人
Mai Naiqiu 麦乃求	Shanghan fa yan 伤寒法眼	1876	Guangdong, Xiangshan	No
Pan Mingxiong 潘明熊	- Ye'an kuoyao 叶案括要 - Pingqin shuwu yilue 评琴书屋医略	1864 1865	Guangdong, Panyu	诸生
Pan Shicheng 潘仕成	Haishan xianguan Congshu 海山仙馆丛书	1850	Guangdong, Panyu	副榜
Qiu Xi 邱熺	Yindou lue 引痘略	1817	Guangdong, Nanhai	No
Ding Naiqian 丁乃潜	Zhouxing lou yi'an 昼星楼医案	1902	Guangdong, Jieyang	廪生
Wang Xueyuan 王学渊	Shuzheng zhinan 暑症指南	1843	Guangdong, Maoming	No
Yan Erwu 颜尔梧	Yanke yuebian 眼科约扁	1880	Guangdong, Lianping	捐职按察司照磨
Yu Tingju 俞廷举	Jintai yihua 金台医话	1783	Guangxi, Quanzhou	举人

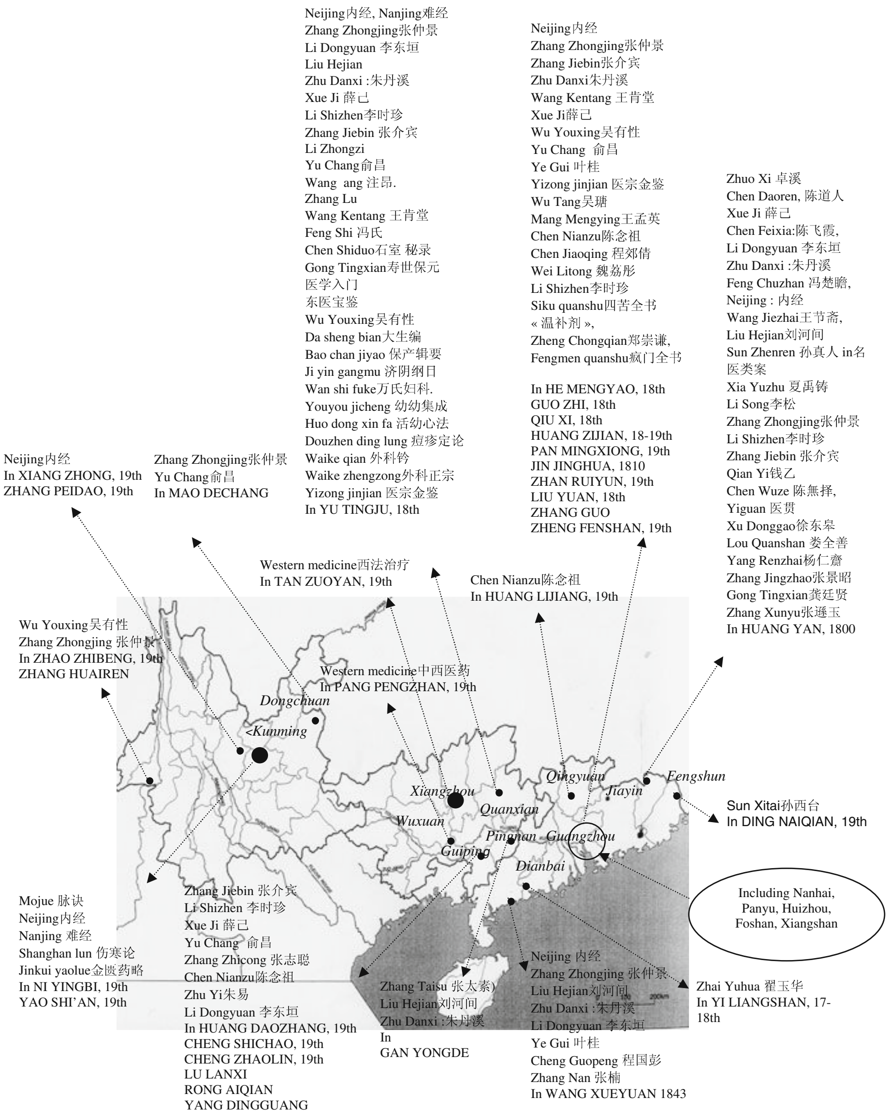


Fig. 1 Texts or authors quoted by medical experts and medical writers of the far south

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Imperial Science Written in Manchu in Early Qing China: Does It Matter?

Catherine Jami

Historiography and Language: China or the Qing Empire?

In the middle of the seventeenth century the Manchus conquered China, taking Beijing in 1644. Their empire extended well beyond the territory controlled by the previous dynasty, the Ming (1368–1644). At its greatest extent, it had five official languages: Chinese, Manchu, Mongol, Tibetan, and Uighur. However, during most of the twentieth century, despite the mass of documents in Manchu kept in archives, the historiography of China under the Qing (1644–1911) relied almost exclusively on sources in Chinese. This has contributed to the construction of an image of China as an immutable empire where, for more than two millennia, the Chinese language was the sole vehicle of bureaucratic as well as scholarly communication, and where all foreign conquerors had to give up their own cultural identity if they were to rule successfully.

In the past two decades, however, this historiographical situation has begun to change. Until then only a few specialists in the Manchu language, who published mainly in German and in Japanese, had long emphasised the importance of Manchu sources for Chinese history.[1] Taking their point on board, and relying on their work, more and more historians of late imperial China have learnt to read Manchu, and have started to use the Manchu documents in the archives. Combining these with sources in Chinese, they have proposed a new vision of the Qing Empire, pointing out that what used to be Ming China only occupied one third of its territory. They have argued that Qing rulers aptly constructed different images of themselves to best match the cultures of the various people they controlled. They have also made apparent how the Republic of China (1912–1949), and then the People's Republic of China (since 1949), whose borders are those of the Qing Empire – except for what is now the Republic

[1] For a bibliography, see (Stary 1990 and Stary 2003).

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DOI 10.1007/978-90-481-3676-6_12, © Springer Science+Business Media B.V. 2010

of Mongolia – have appropriated the Qing legacy as essentially, nay exclusively, "Chinese".

This appropriation, combined with the hostility of early twentieth century Chinese politicians and intellectuals against the Manchus, has shaped even the apparently more technical aspects of historiography. An interesting example is the date of the beginning of the Qing dynasty, and therefore of the proper way to quote a date for the period: this apparently neutral issue was as fraught with implications in the twentieth century as it had been in the seventeenth.[2] The date accepted today is 1644, when the Manchu took Beijing and made it their capital. However the formation of the Manchu dynasty can be traced back several decades earlier, to Nurhaci (1559–1626), the grandfather of the Shunzhi emperor (r. 1644–1661), who first reigned from Beijing. In 1636, under Nurhaci's son Hong Taiji 皇太極 (1592–1643),[3] the state that was to overtake the Ming changed its name from Jin 金 – after the dynasty who controlled Northern China between 1115 and 1234 – to Qing 清.[4] The adoption of this new name was intended as the foundation of a new dynasty, following the model of the Chinese tradition. The Ming dynasty, on the other hand, survived until 1662 as the "Southern Ming"; in fact it was not until 1681 that the empire was securely unified under Qing control.[5] During this long and uncertain transition, the choice of using one or the other reign for dating written material was a token of allegiance to one or the other dynasty. It is significant that a number of early Qing Chinese scholars used the traditional sexagesimal cycle alone to mark the years, avoiding both positive allegiance to and explicit rebellion against the conquerors. The Republic of China, founded in 1912 after the fall of the Qing, was constructed on anti-Manchuism; its capital was Nanjing, which had been the first Ming capital. An example of how the historiography of the Republican period was shaped by this reference to the Ming precedent is a widely used table of correspondence between the Chinese and Western calendars, first published in 1940 and still regarded as a reference tool today: for the years 1644–1661, it gives only the Southern Ming reigns. A broader study of Republican historiography would be required to show to what extent this example is representative; what matters here is that one should be aware that basic research tools such as this chronological table, which gives a correspondence between "the Chinese" calendar and "the Western" one over 2000 years, are underlain by assumptions of legitimacy of the power that issued the calendar.[6] In any case, after the People's

[2] (Rawski 1996).

[3] Traditionally erroneously called "Abahai" in Western sources (Hummel 1943, 1–3).

[4] (Roth Li 2002, esp. 63; Elliott 2001, 71–2).

[5] (Struve 1984; Wakeman 1985).

[6] (Xue Zhongsan and Ouyang Yi 1961); this is not only an issue for Chinese history: the tables use the Julian calendar up to 1582 and the Gregorian calendar thereafter. But protestant countries like Sweden and England only adopted the latter in the middle of the eighteenth century: thus in the period under discussion neither "China" nor "the West" had a unified way of denoting dates.

Republic of China was proclaimed in Beijing in 1949, a consensus seems to have emerged that the Qing dynasty began in 1644, when Beijing became the Qing capital.[7] The notion that different ways of dating simply reflected the fact that there were two simultaneous centres of power, and that historians do not need to and should not choose between them, but simply note their respective claims to legitimacy, has not yet found its way into mainstream historiography.

Apart from the dates of the Qing dynasty, it is worth reflecting on the terms "Chinese" and "Manchu", used to refer to the conquered and to the conquerors, and to their respective languages. Since the present article is written in English, European usages as well as Chinese terms need to be taken into account. In the late seventeenth and eighteenth century, European literature mainly referred to the Qing Empire as "China". More specific phrases were sometimes used. For example, the title of Du Halde's famous work, *Description… de l'empire de la Chine et de la Tartarie chinoise*,[8] represented "Tartary", i.e. the lands from which the Manchus originated, as part of the Chinese empire, rather than China as integrated into a Tartar empire.[9] The word Manchu was also used; however "Tartar" seems to have dominated in European literature. As to the people who inhabited the empire, a distinction was usually made between "the Chinese", and "the Tartars". This reflects the strong divide between Bannermen and "Han people" (*hanren* 漢人) – the conquerors and the conquered – enforced in the Qing Empire. The former were in turn divided into the Manchu, the Mongol and the "Chinese military" (*hanjun* 漢軍) members of the Eight Banners (*baqi* 八旗), the units into which the conquerors of China and their allies had been organised since the early seventeenth century.[10] Named after the Han dynasty (206 BCE-220 CE), the Han were the numerically and culturally dominant group in Ming China. In this context the word "Chinese" as used in English is quite ambiguous: it can refer either to the inhabitants of the "Middle Kingdom" (*Zhongguo* 中國, which is still the name of China in Chinese today) or to members of the "Han Chinese" group, as opposed to all the other groups of which the empire and then the Republic and the People's Republic are composed.

The name "Manchu" (transliterated into Chinese in various ways) was adopted by Hong Taiji in 1635, that is, after the unification of the regions that today form Heilongjiang 黑龍江 and Inner Mongolia had been achieved, and only nine years before Beijing was taken. This new entity referred to the polity that had hitherto been known as Jušen, a term that Hong Taiji banned when coining the new one. It was one year later that he chose Qing as a new dynastic name. He was thus the first emperor of the Qing dynasty, although he never ruled over the territory of Ming China.

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[7] (Struve 1984, xiii–xiv).

[8] (Du Halde 1735; see Landry-Deron 2002).

[9] On the construction and history of "Tartary", see (Elliot 2000).

[10] (Rawski 1998, 61).

The construction of the Manchu written language as used in the documents produced after 1644 is concomitant to the construction of the "Manchu people" and of the Qing state. In 1599 Nurhaci, having unified the Jušen tribes, ordered the creation of a script to render the regional variety of Manchu of current usage. A new version of this script, with diacritical marks added to it around 1640, became the official writing system of the Qing dynasty, and was kept in continuous usage for the Manchu side of the state administration.[11]

So interestingly the Manchu script predated both the terms that were later used to refer to it in Chinese: *qingwen* 清文 ("Qing script") and *manwen* 滿文 ("Manchu script"). As to the lexicon of the language, it was progressively shaped and defined. Glossaries were published in order to standardize the language, until as late as the eighteenth century.[12] This process of the construction of a language as part of that of a dynasty, which was probably not an easy task, would require further study. On the other hand, after the conquest of China, there was a progressive change in the languages spoken by Bannermen: they originally spoke a form of Manchu; gradually, especially through the eighteenth century, Chinese became predominant among the Manchu Bannermen living in China proper, while hybridization and bilingualism continued to survive.[13] This means that by the end of the eighteenth century Manchu survived first and foremost as an administrative language. Eventually its survival was so intimately dependent on the Qing state that, when the language ceased to be used in official documents after 1911, it mostly fell into oblivion. This is one of the reasons for the little use made of the material written in Manchu in the twentieth century. Thus ignorance of the language in which they were written, together with Chinese nationalistic and anti-Manchu feelings, explains why sources in Manchu have largely been left aside by historians of Qing China in the twentieth century.

As the language of the state, Manchu obviously had a specific status in the Qing Empire. On the one hand, it functioned as a means to restrict the circulation of information to the circle of officials who had mastered the language. Many bilingual administrative documents kept in the archives contain passages in Manchu that were deliberately not translated into Chinese; such passages usually bear the mention "Do not translate".[14] On the other hand, at an early stage the translation of a number of works from Chinese into Manchu served to introduce young Bannermen to Chinese culture.[15] More generally, the creation of a body of Manchu literature was an essential aspect of the definition and perpetuation of a "Manchu identity", a means for the rulers to differentiate

[11] (Crossley and Rawski 1993, 66).

[12] Those produced during the Qianlong reign (1736–95) have been published in (Zhang Hong *et al.*, 1993–2005).

[13] (Ch'en 1976; Wadley 1996, 103; Di Cosmo 1999, 356, 387).

[14] (Crossley and Rawski 1993, 68–73).

[15] (Crossley 1999, 190–1).

themselves from the populations they controlled. Since in the Chinese tradition writing was equated with the foundations of civilisation, creating a corpus of written literature in Manchu allowed the assertion of difference while abiding by Chinese cultural imperatives. But it was also a way of taking up the Inner Asian heritage: the Liao 遼 (907–1125), Jin 金 (1115–1234) and Yuan 元 (1279–1368) dynasties had all produced autochthonous scripts.

The implications of this renewal of the historiography of Qing China based on the inclusion of sources in Manchu for the study of the history of science, technology, and medicine have yet to be fully drawn. Medicine has been the subject of a number of learned articles; the first attempt at a systematic overview has been published recently by Marta Hanson,[16] who pleads for the importance of the medical material in Manchu. However it is not yet possible to assess the extent to and the ways in which this material might change our view of medicine, let alone of science in general, in Qing China. A census of medical texts has yielded a mere 29 titles,[17] while my attempt at listing mathematical works has so far revealed the existence of no more than four, for all of which Chinese versions are also extant. Given that Manchu collections around the world are in great part catalogued, the neglect of their scientific components may not after all have resulted in as distorted a view of the historiography of science in late imperial China as has been the case for history. That is certainly the case if one conceives history of science merely as the assessment of what knowledge was available at a certain time in a certain place. But if one aims at integrating the history of science into political and cultural history, these admittedly few texts should be taken seriously as evidence of an imperial policy in relation to learning. Moreover, it will be argued below that their very existence should lead us to reconsider another important issue, that of contacts between China and Europe in the seventeenth and eighteenth centuries.

Western Learning (*xixue* 西學) and the Dynastic Transition

At the end of the sixteenth century, that is, in terms of Chinese chronology, in the late Ming period, some Jesuits entered China, and established a mission. In their evangelising enterprise, they used natural philosophy and the mathematical sciences as they were then taught in Jesuit colleges in Europe as a means to relate to scholarly elites; this knowledge came to be known in China as "Western learning". Thus in 1607 Matteo Ricci (1552–1610), who is regarded as the founder of the Jesuit mission of China, translated the first six books of Euclid's *Elements* into Chinese in collaboration with Xu Guangqi 徐光啟 (1562–1633), a high official who had converted to Christianity.[18]

[16] (Hanson 2005) includes a bibliography of earlier studies.
[17] (Walravens 1996, 359).
[18] On this translation see (Engelfriet 1998).

In 1629, some Jesuits started working on a calendar reform under the supervision of Xu Guangqi; he had also contributed to an effort by a group of Christian officials to implement Western artillery in the Ming army.[19] The calendar had always been of utmost symbolical and political importance in China; issued in the emperor's name, it ensured that human activity followed the cycles of the cosmos. Discrepancies between the former and the latter would therefore cast doubt upon a dynasty's legitimacy. Thus Xu's calendar reform was but one element in the response to the dynastic crisis that would lead to the downfall of the Ming.

The Qing adopted the calendar that resulted from Xu's reform as soon as they took Beijing in 1644, and the Jesuits found a niche in the civil service.[20] The calendar they calculated every year thereafter was promulgated in three different languages: Chinese, Manchu and Mongol.[21] In 1664, however, Jesuits astronomers and their Chinese Christian collaborators were impeached and jailed following accusations of miscalculation and heterodoxy, in what is known as the Calendar Case; five of the collaborators were executed, while missionaries were either expelled or kept under house arrest. One of the first steps taken by the Kangxi Emperor (r. 1662–1722) in his assumption of personal rule in 1669 was to reverse this verdict and to reinstate the Jesuits as imperial astronomers; thereafter their skills were also used in other fields, such as cartography and military technology.[22] It remained an issue, however, whether foreign rulers could ground their legitimacy on a calendar calculated by other foreigners.[23]

Although it is not yet visible in popularisation literature, the historiography of Christianity in China and that of Western learning have undergone parallel renewals in the past two decades. Whereas materials in European languages once were the main and sometimes the sole sources used by European and American historians for writing this history, it is now acknowledged that one needs to combine this material with sources in Chinese – and in Manchu – in order to retrieve a fuller picture of the complex enterprise of the importation of a foreign religion into China.[24] Historians of Christianity in China have by and large given up two assumptions concerning the circulation of religion that were both inherited from Eurocentric worldviews: first, that due to its universal value and truth, the Christian religion spreads "naturally", unless obstacles are raised against its circulation by the Devil or by local superstitions; secondly, that it is desirable that the Christian religion should spread without changing, for the

[19] On the calendar reform see (Hashimoto 1988). On the whole Xu's efforts were more successful in astronomy than in military technology (Huang 2001).

[20] (Standaert 2001, 689–710 and 711–37).

[21] (Smith 1991, 75; Golvers 1993, 63).

[22] (Standaert 2001, 760–3, 772).

[23] (Chu 1997).

[24] (Gernet 1982) pioneered this change, showing Chinese scholars' viewpoint on Christianity; (Standaert 2001) is representative of the new historiography.

salvation of the heathen, and therefore in their interest, which missionaries understand better than they do themselves.

Similarly, a number of historians of science who work on Western learning in China have given up expecting that science should be the same in various times and places and lamenting the limitations of the transmission of science from early modern Europe to China, and analysing the history of Western learning in China in terms of misunderstanding or "imperfect transmission". This phrase, taken from the part of *Science and civilisation in China*'s section on astronomy devoted to "The time of the Jesuits", suggests that there is a message of truth that should not be altered by circulation, and neatly summarizes the historiography that has dominated in the past 50 years. In his discussion, Joseph Needham is, as always, nuanced in his analysis. However a single sentence has very often been quoted as summarising his conclusions: "Urania's feet were bound".[25] Scholars have striven to pinpoint the culprits for this regrettable fettering; all have been accused: the Jesuits, who personify religion's enmity to science,[26] "the Chinese", who are just too different from "us",[27] and the Manchu rulers, who are just Barbarians.[28] An alternative viewpoint has been developed in the last two decades, according to which the circulation in China of the knowledge imported by the Jesuits should be accounted for without any assumption that one form of science is superior to all others, but rather in terms of how knowledge is constructed in the very process of circulation.[29] This viewpoint yet has to make its way into mainstream historiography.

As suggested above, the sciences played a major role in the continued existence of the mission through the dynastic transition; this continuity has dominated the historiography. Narratives of the mission based solely on missionaries' reports often failed to take into account the major changes brought about in Western learning by the dynastic change. However it is now well established that the reception of this learning among the Chinese elites, as well as the Jesuits' status, changed radically with the advent of the Qing. In the late Ming, Western learning was mainly taken up by converts, or by scholars who had personal relations with one or more Jesuits. In early and mid-Qing, on the other hand, Western learning was no longer accepted or rejected as a whole: debates on the respective merits of Chinese learning and Western learning focused on technical details. Moreover hostility towards the missionaries and their religion was often combined with strong interest in the mathematics and astronomy they had written about in Chinese. The links between this hostility and the Jesuits' prompt switch of allegiance to the Manchus remain to be

[25] (Needham 1959, 450).

[26] This is closest to Needham's assessment: "The Jesuits were the prisoners of their limited motivation".

[27] (Wong 1963).

[28] (Xi Zezong 2000).

[29] See e.g. (Chu 1997, Jami 2002).

assessed. The China Jesuits, having worked on a calendar that was to contribute to reforms aimed at strengthening the Ming, instantly offered the result of this work to the invaders, thus giving them the indispensable legitimacy that an accurate calendar traditionally conferred on rulers.[30] After the reinstatement of the Jesuits as imperial astronomers in 1669, criticising Western astronomy could thus entail an implicit questioning of the legitimacy of the Qing. The gradual reconciliation of Chinese elites to Manchu rule, however, did not put an end to the debates and controversies that opposed Western learning and Chinese learning in the sciences: by then the religion preached by the Jesuits aroused but little interest among the elite.

With the advent of the Qing, Western learning thus moved closer to the centre of power and further away from literati elites. The fact that Kangxi, the second emperor of the Qing dynasty to rule China, undertook to study this learning further changed its status. It is at this juncture that taking Manchu sources into account matters.

Science as Imperial Scholarship During the Kangxi Reign (1662–1722)

In what follows, the stakes underlying the use of the Manchu language as a vehicle for imperial science during the Kangxi reign will be discussed, taking into account sources in Chinese and European languages, as well as in Manchu. That the court was the main and possibly the sole place of production of scientific literature in Manchu at the time explains this narrowing of the focus. The Kangxi reign is of particular interest for this question, for two reasons. Firstly, after the final establishment of central control over the Chinese territory, and the quelling of the Three Feudatories rebellion (1674–1681),[31] a lengthy period of stability ensued, during which the emperor had the leisure to pursue a systematic cultural policy. Secondly, his personal interest in the sciences meant that unprecedented emphasis was put on them throughout his reign.

Imperial patronage of learning in the Chinese language was an important aspect of the policy of reconciliation of the Chinese literati elites to the Manchu rule. It entailed the recruitment of some of these literati in the service of the dynasty for the production of new editions of texts of classical learning, or of new texts. The best known example of this is the founding, in 1679, of the Ming History Office (*Mingshiguan* 明史館), where the compilation of the official history of the previous dynasty was undertaken, following the Chinese tradition that a new dynasty should act as the historiographer of its predecessor. A special examination had been organised to staff this Office,[32] which continued

[30] (Jami 2005a, 203–4).

[31] (Spence 2002, 136–47).

[32] (Wilhelm 1951).

to exist until the official *Ming History* (*Mingshi* 明史) was completed in 1739, long after Kangxi's death, under the reign of his grandson. In other cases Kangxi was directly involved in the production of imperial scholarship. Thus in 1671, that is, two years after the beginning of his personal rule, he recruited a number of Daily Tutors (*rijiangguan* 日講官) among Hanlin 翰林 academicians, those scholars who had ranked best at the previous Metropolitan examination, by which high officials were recruited:[33] while still quite junior, they later pursued careers at the highest level. With these Tutors the emperor studied the Classics, which were regarded as the founding texts of Chinese civilisation, and formed the core of the curriculum of imperial examinations; in the process lecture notes were produced, carefully revised by tutors and student, to be printed as imperial publications. Between 1678 and 1749, such "Explanations of the meaning of [...] during daily tutoring" (*Rijiang...jieyi* 日講...解義) were published for the Four Books as well as the Five Classics.[34]

Kangxi's study of the sciences followed the same pattern as that of the Classics: he was tutored in them, and some of the tutoring resulted in imperial publications. As for the *Ming History*, a special office was created in 1713 for the compilation of these publications: the Office of Mathematics (*Suanxue guan* 算學館).[35] In the case of the sciences, however, neither the tutors nor the corpus of knowledge they taught were Chinese; the Jesuits tutored the emperor in Western learning. Nonetheless, like classical scholarship, Western learning can be regarded a legacy of the Ming dynasty that the Manchu rulers promptly took up. It was a feature peculiar to Kangxi that he had such long-lasting interest in it. According to him, he had resolved to study it after becoming aware of the general ignorance of astronomy among high officials at the time when the verdict of the Calendar Case had been reversed.[36]

This is the story of Kangxi's study as it has been told from sources in Chinese and in European languages.[37] Like the whole story of Western learning in China, it is bipolar: China and the West. In fact some of the Jesuit tutors of the emperor spoke both Chinese and Manchu. Similarly, Daily Tutors had all studied Manchu after passing the Palace examination. Imperial study, like administration, was bilingual. This implied that there should be translations of the Chinese classics into Manchu; these had first been undertaken under the reign of Hong Taiji, before the Manchus took Beijing.[38] In the field of Western learning, on the other hand, texts were produced in either Chinese or Manchu, and some of them were translated from one language into the other. This

[33] The examination system is one of the many Ming institutions that the Qing took up at the very beginning of the dynasty.

[34] (Zhao 1977, 2483, 4221, 4226, 4236, 4244, 4248).

[35] (Jami 1994a, 238–241).

[36] (Jami 2002, 31).

[37] See e.g. (Kessler 1976, 137–54).

[38] (Crossley and Rawski 1993, 91–2).

reflects the emperor's perception of Western learning as a repository from which he drew both techniques for statecraft, over which he might keep a monopoly, and material for scholarship, which he might share with Chinese literati. He used the Jesuits not only as technical (*shu* 術) experts in his service, but also as providers of information that could pertain to the category of learning (*xue* 學), the value held paramount by his Chinese scholar-officials, who were confident that they had a monopoly over it.

The use of the Manchu language implied a restricted availability of information. On the other hand, the use of Chinese made possible not only circulation among all literati, but also a claim to the status of learning for the sciences; such a claim could never be made for writings in Manchu, since classical Chinese remained the sole vehicle of knowledge universally acknowledged among literati. In what follows, I propose to show the implications of imperial choices regarding the languages in which texts of Western knowledge were available. For this purpose texts pertaining to natural philosophy and to the mathematical sciences in the Jesuits' classification of knowledge will be considered. But let us first briefly discuss the study of Chinese and of Manchu by the Jesuits who tutored the emperor.

Learning the Ruler's Language

The Jesuits who entered China as missionaries all studied the spoken language of the elite; at the end of the Ming, that was Southern Mandarin.[39] They also learnt classical Chinese, and acquainted themselves with the Classics.[40] This did not drastically change with the dynastic transition, as the vast majority of missionaries worked in the provinces. Only some of the very few who were in the service of the rulers learnt Manchu; some of them only communicated with Kangxi in Chinese.

The emperor's first tutor in the sciences was Ferdinand Verbiest (1623–1688), whom he had appointed Administrator of the Calendar (*zhili lifa* 治理曆法) after the reversal of the verdict in the Calendar Case. Verbiest recounted how he started studying Manchu in 1675[41]:

> When the Emperor heard from me that the books of Euclid made up the prime elements of the whole mathematical science, he immediately wanted the first six books of Euclid, which had once been translated into Chinese by Father M. Ricci, to be explained to him. [. . .] Although he knew Chinese very well, [. . .] he nevertheless wanted the Chinese Euclid to be translated into Manchu, to gain some further help from this. Since the dignitaries generally use the Manchu language, and since it is frequently used in almost all the Ministries, he also sent me, in his exceptional favour, an instructor, one of his home servants, to teach me the Manchu language [. . .].[42]

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[39] On this language see (Coblin 1997).

[40] (Brockey 2002, 313–74).

[41] This is the date given by (Golvers 1993, 266, n. 102)

[42] (Golvers 1993, 99).

The translation of Euclid seems to have hardly circulated, and to be no longer extant. As Verbiest points out, at the time, Kangxi was fluent in Chinese; having the *Elements of geometry* translated into Manchu was part of his policy of systematic creation of a body of written literature in his native language.[43] It is unlikely that at the time anyone in the imperial entourage or among Bannermen might actually have needed this translation in order to study geometry, as by that time Manchu scholars mastered literary Chinese. While Verbiest was fully aware that speaking Manchu would be a great help to him as a civil servant, Kangxi's order that the Jesuit should study Manchu also formed part of the imperial construction of this language.

Ten years later, three other Jesuits worked with Verbiest as astronomers and court savants: Claudio Filippo Grimaldi (1638–1712), Tomé Pereira (1646–1708), and Antoine Thomas (1644–1709). Of these only Grimaldi knew Manchu well enough to translate both scientific and religious books into that language.[44] Thomas and Pereira, on the other hand, both tutored the emperor in Chinese –Thomas in mathematics, Pereira in music. This is probably the reason why it was Grimaldi who was appointed as Verbiest's successor as Administrator of the Calendar upon the latter's death in 1688.

Shortly after Verbiest's death, five French Jesuits appointed as correspondents of the Paris Academy of Sciences arrived in Beijing. They had been sent by King Louis XIV as "his Mathematicians".[45] The Jesuit mission of China had hitherto been under the sole patronage of Portugal, who in 1494 had been granted a monopoly over missions in Asia by the Pope.[46] The French were received as competitors by most of their confreres who were already working in China; the latter gave priority to their allegiance to their Portuguese patron, on whom they were financially dependent, over their loyalty to the Society of Jesus as a whole. These included not only Pereira, himself a Portuguese, and the superior of the Beijing house since Verbiest's death, but also the Visitor of the Society for China and Japan, Francesco Saviero Filippucci (1632–1692), who forbade the study of Manchu to the five Frenchmen.[47] Nonetheless, Jean-François Gerbillon (1654–1707) and Joachim Bouvet (1656–1730), the two among them who were appointed by Kangxi in his service, did learn that language at his request. Gerbillon recounted a dialogue he had with the emperor in January 1690:

> I always spoke to him in Tartar, but I would not undertake to give mathematical explanations: I apologised to His Majesty that I did not know either the Chinese or the Tartar language well enough to speak to him relevantly, especially regarding the sciences, not knowing the appropriate Chinese or Tartar terms: but I told him that when we would have learnt Tartar well, F. Bouvet and I would be able to give him lessons in mathematics or in philosophy very clearly and neatly, because the Tartar

[43] (Crossley and Rawski 1993, 91–5).

[44] (Golvers 1993, 267 n. 102).

[45] (Landry-Deron 2001).

[46] (Standaert 2001, 286–7).

[47] (Landry-Deron 1995, 1:50, 54).

> language by far surpasses the Chinese language, in that the latter has no conjugations, no declensions, no particles to link discourses, whereas in the former they are very common. The emperor seemed pleased with this speech, and turning to those around him: this is true, he told them, and this defect makes the Chinese language much more difficult than the Tartar one.[48]

Missionaries who studied both languages all agreed that Manchu was far easier, especially due to the difficulty of memorising Chinese characters.[49] It is very common, even nowadays, for those who confront the difficulties of classical Chinese to ascribe these difficulties to its supposed grammatical shortcomings. This being said, the assessment of Manchu in terms of its similarities with European languages clearly delighted the emperor. His language was deemed more appropriate than Chinese for the purpose of expressing Western learning: here was at least one field in which he did not have to defer to his scholar-officials. Following this conversation, he appointed some teachers to help Gerbillon and Bouvet make progress in his language, as he had done with Verbiest. The first result of this intensive study was a short treatise on digestion, composed at the beginning of 1690 with the help of their teachers, which the emperor himself corrected.[50]

Natural Philosophy and Medicine: Restricting Access to Heterodox Writings

As with Verbiest, then, the two French Jesuits' study of Manchu was part of Kangxi's policy of constituting a corpus of Western learning in Manchu. After digestion, they dealt with a number of other medical topics in similar short texts, all illustrated. This was part of their larger project to teach philosophy to the emperor, as a step towards converting him.[51] The latter, on his side, insisted that they should show their writings to no one else than him.[52] This secrecy was not limited to medical topics, but extra caution was shown on subjects related to what pertained to natural philosophy at the time in Europe. This probably resulted from an earlier experience: in 1683, Verbiest had presented him a treatise in Chinese entitled *Qiongli xue* 窮理學 ("Study of the fathoming of principles"), asking that it be printed and promulgated.[53] He hoped to substitute the Jesuit version of scholastic education for the Chinese Classics: *qiongli* 窮理 was the term that he borrowed from Neo-confucian philosophers, as his predecessors had done, to render the Latin *philosophia*. The *Qiongli xue* was a

[48] (Landry-Deron 1995, 2:11–2).
[49] (Golvers 1993, 267, n. 102).
[50] (Landry-Deron 1995, 2:36).
[51] (Jami 2005b, 218–20).
[52] (Landry-Deron 1995, 2:34–5).
[53] (Dudink and Standaert 1999; Golvers 1999).

compilation of Aristotelian texts written in Chinese by Verbiest's predecessors of the late Ming period, from which he had deleted all references to the Christian religion. Kangxi discussed the treatise with some Hanlin academicians: its title was a claim that it pertained to scholarship. There was a consensus in assessing the *Qiongli xue*. According to the emperor, "the contents of this book [were] rebellious, erroneous and obtuse." His officials argued, more specifically, that "all [Verbiest said] about knowledge and memory pertaining to the brain and so on indeed [strayed] away from principles".[54] In their view, knowledge and memory pertained to the *xin* 心 ("heart" in the abstract sense, sometimes translated as "mind and heart"), which was certainly *not* located in the head. In short, competent as he might be in technical matters (*shu* 術), Verbiest had no understanding of the principles (*li* 理) that underlay genuine, orthodox learning (*xue* 學).

This experience probably explains why Kangxi insisted that the Jesuits should keep their medical writings secret. Indeed the emperor endorsed the condemnation of Verbiest's *Qiongli xue* as heterodox; this was duly recorded in Chinese by imperial diarists. Nonetheless he kept an active interest in Western medicine – which the Jesuits regarded as a part of philosophy – using the Manchu language for this purpose.[55] Beside the material produced by Gerbillon and Bouvet, which appears to be no longer extant, a work on Western pharmacopoeia written for Kangxi is still kept in Beijing at the Palace Museum Library.[56]

The work best known today among those commissioned by Kangxi on European medicine is a treatise on anatomy in Manchu composed by Dominique Parrenin (1665–1741), a French Jesuit who worked at court in the late years of the reign.[57] According to him, Kangxi's original plan was to have the work eventually translated into Chinese, on the grounds of its usefulness; but at the same time the emperor was concerned that the illustrations might shock:

> [. . .] The public must draw great advantage from this book, as it must contribute to save, or at least to lengthen, life. It is not a book to be shown to young men: thus, the illustrations must only be seen by those who will share the work with you.[58]

Following the emperor's commission, Parrenin worked for five years to produce a Manchu treatise.[59] In its title, *Dergici toktobuha Ge ti ciowan lu bithe* ("Complete record of the body, Imperially commissioned"), one can discern a transcription from Chinese (*Geti quanlu* 格體全錄).[60] Parrenin was assisted by "three Mandarins of the most skilled, two writers whose hand was excellent, two

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[54] Quoted in (Dudink and Standaert 1999, 17).

[55] (Dong 2004, 69–102).

[56] (Li 1999).

[57] (Walravens 1996, 368).

[58] (*LEC* XVII, 350).

[59] (Walravens 1996).

[60] (Hanson 2005, 145); *bithe* means "book".

painters very capable of drawing figures, line drawers, designers etc."[61] This points to a general contrast in Western learning. In the late Ming many of the Jesuits' works were jointly signed with one or more Chinese scholars, without whom they could of course not have been produced. During the Kangxi reign some Manchus – and also possibly some Chinese – who worked in the Imperial Household Department (*Neiwufu* 内務府) had obviously significant competence in the sciences, and contributed to the texts discussed here. However their existence is only mentioned in passing if at all in Jesuit sources, and these texts are not signed; neither do other materials in Chinese or in Manchu known and studied so far tell us more about them. On the whole, those who contributed to writing Western learning in Manchu are more anonymous than those who contributed to it in Chinese.

Once the Anatomy was completed, the emperor decided that it was not to be translated into Chinese, and that there should be only three copies of the text, to be kept in different imperial libraries.[62] This decision not to circulate an imperially commissioned work is probably related both to the allusions to the "invisible soul" and to the "Lord who created the things" found in it,[63] and to the earlier assessment of Verbiest's *Qiongli xue*. Here two features of Kangxi's attitude as a patron of scholarship seem to converge: his abiding by Chinese orthodoxy and his policy of controlling, and sometimes monopolizing, Western learning. In both these respects the Manchu language was a valuable tool.

Mathematical Sciences for the Emperor and for the Empire

The subjects that Kangxi studied most systematically with the Jesuits were also those in which Western learning had the greatest impact in China. As mentioned above, he first turned to astronomy and to geometry. He was interested more broadly in mathematics, in which he received further tutoring in the 1690s and the 1710s. He was also tutored in the practice of the harpsichord, as well as in harmonics, a topic essential to ritual, and related to astronomy in traditional Chinese classifications.[64] There was thus a convergence between the scholastic *quadrivium* (i.e. arithmetic, geometry, music, and astronomy) on which Jesuit education in the mathematical sciences had been constructed, and the cluster of topics on which the court Jesuits wrote most extensively for the emperor.

In 1690 and 1691, sessions of tutoring in Western learning took place almost every day.[65] Beside the two French Jesuits who taught in Manchu, Gerbillon and Bouvet, two other tutors taught in Chinese: Thomas and Pereira. The latter often served as an interpreter for Thomas, whom some sources describe as not being totally fluent even in Chinese, but who, on the other hand, had specialised

[61] (Walravens 1996, 365).
[62] (Jami 2002, 43).
[63] (Walravens 1996, 370).
[64] (Jami 2008).
[65] (Landry-Deron 1995).

in the mathematical sciences years before leaving Europe.[66] The emperor's intention seems to have been that all the lecture notes should be available both in Chinese and in Manchu; they were designed to be printed and circulated. This seems to be an example of his plan to create a scholarly literature in Manchu in parallel with Chinese. A number of manuscripts of these lecture notes are still extant, mostly in Chinese, a few in Manchu.

The most famous of these is certainly a treatise of Euclidian geometry based on a French textbook, I.G. Pardies' *Elemens de geometrie*.[67] Gerbillon and Bouvet substituted it for the Clavius edition of Euclid's *Elements*, on which the Ricci-Xu translation of 1607 and the Manchu translation undertaken by Verbiest were based.[68] The two Frenchmen completed their Manchu treatise in 1690, and its Chinese translation the following year.[69] Both the 1607 and the 1691 Chinese treatises were entitled *Jihe yuanben* 幾何原本: this reflects the fact that in Europe "Elements of geometry" had come to refer to a genre, that of geometry textbooks, rather than to Euclid's work in particular. Again the Manchu title was a phonetic transcription of the Chinese one: *Gi ho yuwan ben bithe*. When working on the Manchu version, the two Jesuits received the help of a translator who had previously worked with Verbiest on the Manchu version of the 1607 *Jihe yuanben*.[70] Like Parrenin's collaborators for the Anatomy, his name remains unknown to us. The work he had previously done with Verbiest, however, meant that a Manchu terminology for geometry was already available to Gerbillon and Bouvet. One feature of the manuscript of their Manchu geometry kept at the Palace Museum Library in Beijing is revealing of the fact that the terminology used in the text was constructed by derivation from Chinese. The Chinese character(s) equivalent to Manchu geometrical terms like point, angle, parallel were added to the left of the corresponding Manchu term (the Manchu script is vertical, and columns are laid out from left to right).[71] Chinese characters seem to be added whenever the corresponding Manchu term occurs, so that one could say that in this particular manuscript the mathematical terms consist of Manchu terms and their Chinese equivalents. Some of the Manchu terms were phonetic transcriptions of their Chinese equivalents; this was the case for the names of points in geometric figures: for those, phonetic transcription of the Chinese heavenly stems and earthly branches (*tiangan dizhi* 天干地支) were used. These are two sequences of characters that combined into the sequence of sixty terms commonly used for

66 (Bosmans 1924–6).

67 (Pardies 1671; see Jami 1996).

68 (Jami 2005b, 217–21).

69 On the various manuscripts kept in China today, see (Liu 1991); another copy of the Manchu text is kept in St Petersburg; (Pang and Stary 2000).

70 (Landry-Deron 1995, 2:48).

71 It is the case in the Manchu manuscript kept at the Palace Museum Library in Beijing (Ms 13716–13718), which is a draft with corrections on pasted pieces of paper, for both text and figures, and a few ones between columns.

numbering the days and the years in the calendar. The ten stems and twelve branches were used in Manchu, under names different from the phonetic transcription of their Chinese names; the use of this phonetic transcription to denote points suggests that the Manchu geometric terminology was conceived entirely in parallel with the Chinese one rather than consistently with other usages of the Manchu language. No other geometrical work in Manchu seems to have been written at the time: although the new imperial textbook existed in Manchu before it did in Chinese and was based on a French source, geometry in Manchu seems to have hardly existed independently from this subject in the Chinese language.

Antoine Thomas was the most prolific author of mathematical lecture notes. He was in charge of teaching arithmetic, and later algebra, which, as mentioned above, he did in Chinese. Several Chinese copies of his treatises have been preserved,[72] whereas only one draft Manchu version of his arithmetic treatise is extant.[73] Tome Pereira had earlier written a treatise on harmonics, also in Chinese.[74] When Kangxi asked Gerbillon and Bouvet to translate it into Manchu, they declined to do so, protesting of their ignorance of the subject. The two Frenchmen were thus repaying their Portuguese confrere in kind for the obstacles he kept raising for the French mission.[75] Pereira's treatise was nevertheless translated, although it is not known by whom.[76] This anecdote suggests that the imperial effort to create a corpus of Western learning in Manchu relied on rather limited human means.

Recently, one of the mathematical manuscripts of lecture notes in Manchu has been the subject of a detailed study.[77] This is a short treatise entitled in Chinese *Suanfa yuanben* 算法原本 ("Elements of calculation"), in Manchu *Suwan fa yuwan ben bithe*. It draws on some parts of books VII and VIII of Euclid's *Elements of geometry*.[78] In writing what is the first and only textual study of any of the Manchu material discussed in this article, Junsei Watanabe had no knowledge of what the manuscript was, or of the existence of its Chinese counterpart. Interestingly, this is the one treatise for which no positive external evidence allows to ascertain authorship. Determining whether the treatise was first composed in Chinese or in Manchu would help clarify whether it should be ascribed to Thomas or to Gerbillon and Bouvet.

Let us give an example of what such a systematic comparative study of the two versions might yield. The term used to render "to measure" in the Chinese manuscript is *dujin* 度盡, literally "to measure and exhaust"; the term was not found in earlier texts of Western learning. In the Manchu manuscript there are

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72 (Han and Jami 2003); (Jami and Han 2003); (Jami 2007).

73 (BnF Mandchou 191).

74 On the successive manuscript versions of this treatise, see (Wang 2002).

75 (Jami 1995).

76 (Landry-Deron 1995, 2:90. Wang Bing 2002, 70).

77 (Watanabe 2005).

78 (Jami 2007, 256).

three successive renderings for the same term, which Watanabe translates as "to measure exactly", "to measure exhaustively", and "to measure and exhaust". Of these three terms, the last one is the closest match with the Chinese *dujin*. This would suggest that the text might have been translated from Chinese into Manchu, which would be consistent with the hypothesis that Antoine Thomas, rather than the French Jesuits, was its author.[79] This being said, the issue of priority between these two versions does not appear to be crucial for our purpose here. What is known of the context in which they were produced points to a desire on the emperor's part to have works on mathematics written in both languages. It may be that these texts were produced simultaneously, or revised jointly, as was the case for some administrative documents.

After the creation of the Office of mathematics in 1713, the Chinese versions of the manuscripts discussed above were used as a basis for the compilation of the *Essence of numbers and their principles imperially composed* (*Yuzhi shuli jingyun* 御製數理精蘊, 1723). This work proposed a definition of mathematics as a synthesis of all sources relevant to the field then available, that is, both Western learning and Chinese mathematical works. It was compiled by a team of scholars, including mostly Chinese, but also some Bannermen, without the collaboration of any Jesuit: imperial science was thus dissociated from the missionaries while it absorbed Western learning.[80] Two other treatises were compiled at the same Office; together with the *Essence of numbers and their principles*, they formed the *Origins of harmonics and calendrical astronomy, imperially composed* (*Yuzhi lüli yuanyuan* 御製律曆淵源). The treatise on astronomy, the *Thorough investigation of calendrical astronomy imperially composed* (*Yuzhi lixiang kaocheng* 御製曆象考成), does not seem to have resulted from tutoring by the Jesuits; it reflected, rather, an attempt at astronomical reform.[81] On the other hand, the third work, a treatise on harmonics, entitled *Exact meaning of pitch-pipes imperially composed* (*Yuzhi lülü zhengyi* 御製律呂正義), included a rewriting of Pereira's work in Chinese, in a separate and final chapter, following four chapters devoted to traditional Chinese harmonics. Thus, in this last subject, Jesuit tutoring resulted in an imperial publication as well.

Unlike some of its counterparts in classical learning produced under imperial patronage during the Kangxi reign, the *Origins of harmonics and calendrical astronomy* was never published in Manchu, nor is there evidence that there was any plan that the Office of Mathematics should work in that language. Thus, apart from a few manuscripts kept in imperial libraries, or sent to Europe by Jesuit missionaries, there remained no trace of the fact that the construction of

79 Watanabe, comparing the text to a later adaptation of the *Suanfa yuanben* published as part of the *Shuli jingyun* (1723), concludes that the latter was derived from the former; (Watanabe 2005, 189–190). Indeed both the Chinese and Manchu versions of the manuscript *Suanfa yuanben* predate the printed one. On the other hand, on the basis of its contents, I have argued that Thomas was more likely than the French Jesuits to have composed the *Suanfa yuanben* (Jami 2007, 468).

80 (Jami 1994b, 204–205).

81 (Hashimoto 1970).

imperial mathematics had started as a bilingual project. This can be interpreted as a failure due to the lack of competent staff, or as a consequence of changing relations between the emperor and Chinese literati. In any case it is also one among several examples of how the Manchu rulers in general and Kangxi in particular strove to project an image of themselves as Confucian emperors, promoting scholarship in the Chinese tradition. That only this particular facet of their multiform rulership is visible through Chinese sources is a measure of their success.

Do Manchu Sources Matter After All?

What do we learn from the admittedly very few sources discussed above? First, that more "Western learning" found its way into China than is visible from sources in Chinese alone. Secondly, that the imperial appropriation of this learning both stimulated the production of new texts and limited their circulation: the Manchu language was instrumental in this double process. The ways in which it functioned as a filter in the circulation of knowledge deserves further analysis.

If one adhered to the idea that science should and does circulate "naturally" unless there are obstacles, then it would follow from this that "the Manchus" in general and Kangxi in particular were just as guilty as the Jesuits for the "binding of Urania's feet." Here paradoxically, overoptimistic universalism and the implicit moral judgment that it contains converge with a representation of the Manchus as "Barbarians" who prevented civilised China from partaking in universal science. The complexity revealed by bringing together all the sources available, however, reminds us that history of science – like all history – is about human agents, without whom science simply does not exist. Only by moving beyond the assessment of achievements and limitations and the rhetoric of praise and blame can we deepen our historical understanding.

Is my conclusion, then, simply that the Manchus were not Chinese, and that this shaped the sciences as it did all aspects of politics, society and culture in the Qing Empire? What else can be drawn from this study than a confirmation of what historians have shown in more general terms? First, it shows, I believe, how the sciences were thus shaped. Secondly, by retrieving an obscured path of circulation of knowledge, it further urges us to do away with the long-lived bipolar historiography, in which "China" and "the West" forever stand face to face as two homogenous and immutable entities.

Acknowledgement I wish to thank to Prof. Nicola di Cosmo for his comments on an earlier version of this article. Responsibility for mistakes is solely mine.

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Sinification as Limitation: Minh Mạng's Prohibition on Use of Nôm and the Resulting Marginalization of Nôm Medical Texts

C. Michele Thompson

For Vietnamese scholars in the late eighteenth and early nineteenth centuries reading and writing ability in both Chinese and *Nôm* (an ideographic writing system used to write Vietnamese) was considered an essential tool of scholarship and literary expression. Indeed, most historians who work on pre-modern Vietnam would agree that "by the 1700's, facility in classical Chinese and *nôm* was expected of the truly versatile Vietnamese scholar."[1] During this time period few physicians who practiced *thuốc nam*[2] were to be found among Vietnam's scholarly elite. However, although these healers practiced a form of healing that occupied a social position "far less prestigious than the scholarly 'northern medicine',"[3] the social and geographic boundaries between the members of the scholar gentry class and other classes in society, even the peasantry, were comparatively more porous than in many other parts of the world, including China.[4] Thus literacy, or at least partial literacy, in classical Chinese and in *Nôm* extended well beyond the scholar gentry class and correspondingly "a relatively large portion of the population acquired some knowledge of

Research for this essay was funded by grants from the Fulbright Foundation, the Social Science Research Council, the University of Washington and the Connecticut State University System. I am indebted to the organizers of, and the participants in, the project "Looking at it from Asia: the Processes that Shaped the Sources of History of Science" for their comments and observations on this essay. All errors of fact or opinion are entirely my own.

[1] (Woodside 1988, 53).

[2] *Nam* means south and south is often used by the Vietnamese to refer to Vietnam or to things Vietnamese. *Thuôc* means drug or medicine, so *thuôc nam* most literally means "southern medicine" and is used by the Vietnamese to refer to Vietnamese Traditional Medicine. North is often used in Vietnam to refer to China or to things Chinese, *Bắc* means north, and *Thuôc Bắc* refers to northern or Chinese inspired medicine. See also, Thompson 1998, Chapter 3.

[3] (Hoang Bao Chau 1993, 5).

[4] (Dror 2007, 120).

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F. Bretelle-Establet (ed.), *Looking at It from Asia: The Processes that Shaped the Sources of History of Science*, Boston Studies in the Philosophy of Science 265,
DOI 10.1007/978-90-481-3676-6_13,

characters and of literary modes."[5] This was certainly true of many practitioners of *thuôc nam*.

However, the second emperor of the Nguyễn Dynasty (1802–1945) set in motion policies and practices that changed this pattern. In 1820, the first year of his reign, Emperor Minh Mạng (1820–1840) prohibited the use of *Nôm* in all court documents and shortly thereafter he also prohibited its use in the royal and provincial level examinations. Scholars agree that the emphasis placed by Minh Mạng, and the emperors of the Nguyễn Dynasty who followed him, on Chinese as the official written language of Vietnam is one of the factors which indicates that this dynasty was by far the most sinified of all Vietnamese dynasties. This move towards what Alexander Woodside refers to as a "Chinese model" had far reaching social effects and the push for Chinese as the written medium of the "educated" classes resulted in a class divide between those who primarily used Chinese and those who were literate only in *Nôm*. This essay will give an introduction to *Nôm* and will examine the place of texts, written or printed, in *Nôm* within the textual traditions of Vietnamese medicine. It will then present the general effects of this policy on the range of documents produced in Vietnam following the implementation of Emperor Minh Mạng's policy regarding *Nôm* and will continue with an examination of the factors which led to an unequal emphasis, in terms of preservation and cataloging, on sources from Vietnam, written and printed, in classical Chinese during and after the French colonial period. This will be compared to the treatment of texts written in *Nôm*, many of which today remain miscataloged, or even completely uncatalogued, and neglected in terms of archival preservation. This essay will conclude with suggestions as to what types of information lie waiting for the scholar in these often overlooked texts.

Description of *Nôm*

By the late eighteenth century three writing systems were used in Vietnam by the Vietnamese.[6] Classical Chinese had been introduced during the first period of Chinese domination (43-939 CE). *Nôm* was the first writing system developed to write Vietnamese and it was in fairly widespread use by the time of the Lý Dynasty (1010–1225).[7] By the late eighteenth century there was also a Romanized alphabetic script, which had been designed by Catholic missionaries in the seventeenth century. This script is now called *Quôc Ngū* and *Quôc Ngū* is the script used to write Vietnamese today. The term *Quôc Ngū* (國語) means

[5] ibid.

[6] This study is limited to scripts used by the majority ethnic group in Vietnam, the Vietnamese themselves and does not involve other ethnic groups in Vietnam, nor the scripts devised to express the languages of any of these peoples.

[7] (Nguyễn Quang Hồng 2008)

national language, however until well into the twentieth century this romanized script was little used outside the small community of Vietnamese Catholics and foreign missionaries. *Nôm* was the first script referred to by the Vietnamese as *Quôc Ngū* (國語) and for at least 900 years *Nôm* was the only script commonly used to write Vietnamese.[8] Scholars agree that *Nôm* was in use by the eleventh century, perhaps earlier, and in some specialized fields, such as medicine, it continued to be commonly used until well into the twentieth century.[9]

There are many academic arguments concerning the origins and development of *Nôm*.[10] Indeed, there are only three points about *Nôm* that most leading scholars in the field agree on. These points are, that *Nôm* characters were derived from Chinese characters, that to be fully literate in *Nôm* a person had to be fully literate in Chinese, and that when Chinese characters were adapted and used in *Nôm* their phonetic value was more flexible than when they were used in Chinese.[11] For a brief introduction to *Nôm* and to begin a discussion of the place of *Nôm* in Vietnamese medical texts it will be useful to discuss these three points.

There is no doubt that *Nôm* characters are derived from Chinese characters and a corollary to this point is that any Chinese character can be used as a Nôm character.[12] When scholars say that *Nôm* characters were derived from Chinese characters they mean two things. First, that *Nôm* was devised after the introduction into Vietnam of Chinese characters and that *Nôm* characters came solely from the written form of Chinese that the Chinese introduced to Vietnam.[13] Second, that the elements used to compose Chinese characters might be put together to make completely new characters that looked like Chinese characters but that did not, and never had been used to, represent any word in the Chinese language.[14] As noted above, any Chinese character could be used as a *Nôm* character and this is most clearly seen in the use of Chinese characters to represent loan words, names, and terms of various sorts which had come into Vietnamese language via Chinese.[15] The pronunciation of these characters was, in general, closer to the phonetic value of the Chinese character they were

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[8] Numerous titles and bibliographic entries which include the Chinese Characters which mean national language and which use this term to refer to *Nôm* can be found in the *Di Sản Hán Nôm Việt Nam-Thủ Mục Đề Yếu; Catalogue des Livres en Han Nom* (Trần and Gros 1993)

[9] (Thompson 1998, 158–226)

[10] (Thompson 2000)

[11] (Nguyễn Tài Cẩn, 1985; Đào Duy Anh 1975; O'Harrow 1981; and Trần and Gros 1993, 17–8 and 49–51).

[12] (Nguyễn Tài Cẩn (1985), 12–5; DeFrancis (1977), 24–5; Woodside (1988), 50–2; and O'Harrow 1981, 160).

[13] For arguments positing an earlier development of Nôm from the Chinese scripts in use prior to this time see (Thompson 2000).

[14] (Nguyen Nam 1992, 14; Woodside 1988, 51; DeFrancis 1977, 25).

[15] (Trần and Gros 1993, 17–8 and 49–50; Nguyễn Tài Cẩn 1985, 13; Đào Duy Anh 1975, 54–8).

written with in Chinese than the pronunciation of most Vietnamese words would be.[16]

The implications of the second point of general agreement regarding *Nôm* among scholars, that to be fully literate in *Nôm* one must be fully literate in Chinese, should be carefully considered before any firm conclusions are reached regarding literacy in *Nôm* in pre-modern Vietnam. In general scholars have used a very narrow definition of "full literacy" with regard to users of *Nôm*. This conventional definition assumes that to be "fully literate" in *Nôm* a reader should be able to not only read *Nôm* characters, in terms of sounding out the words, but also to understand the majority of the allusions to Chinese literature, mythology, and traditions made in such masterpieces of the poet and story-teller's art as *The Tale of Kiều,* composed by Nguyễn Du in the late eighteenth century, or the poems of Hồ Xuân Hủng.[17] By this standard native speakers of English today who read and write on a daily basis in their profession but who do not notice or understand the allusions made by poets such as Robert Frost or Sylvia Plath would be defined as illiterate. Further, applying this arbitrary standard regarding literacy in *Nôm* automatically defined those who used *Nôm* for purposes that did not require elaborate literary allusions, such as medicine, as illiterate or, at best, semi-literate.

If, however, a literacy standard which stresses the ability to use written material in daily life is applied with regard to use of *Nôm* then the evidence from pre-modern medical literature supports the conclusion that to be "functionally literate" in *Nôm* one did not have to be "fully literate" in Chinese.[18] It is important to note that not only is this question closely connected to the third point on which scholars agree, that the pronunciation of *Nôm* characters is highly flexible, but also that there is significant potential value, for modern historians, linguists, geographers and other scholars, in the phonetically flexible texts created by those who may have been only functionally literate. Texts in *Nôm* contain graphic representations of considerable variation in dialect within Vietnamese language. Indeed Keith Taylor describes *Nôm* as "a writing system with a high degree of sensitivity to regional pronunciations and to phonetic change from generation to generation. . . . A single character can refer to as many as a dozen different words, depending upon the time and place it was written; and a single word can be written with as many as a dozen different characters, again depending on the time and place it was written."[19]

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[16] (Maurice Durand and Nguyen Tran Huan 1985, 7–8 and 17; Phan Ngoc 1989; and Nguyễn Tài Cẩn and N.V. Stankevitch 1989, 56–77).

[17] At the first international conference on *Nôm* held in Hà Nôi in November 2004 over 50% of the papers presented were on *Kiều* and other works of literature.

[18] See the definitions of "functional literacy" employed by such organizations as the Organization for Economic Cooperation and Development (International) and National Literacy Trust (UK).

[19] (Taylor 1998, 972).

In *Nôm* Chinese characters were used intact to represent Vietnamese words that were phonetically similar to the sound of a given Chinese character.[20] Also, Chinese characters could be combined, with two characters written together, one for semantics and one for phonetics.[21] The constituent elements of Chinese characters might be combined into new characters and those elements used to represent either phonetic or semantic value.[22] For Vietnamese language as represented by *Nôm*, phonetics were comparatively more important than semantics in the use of Chinese characters. This was true also in the creation of *Nôm* characters from Chinese characters. Because *Nôm* was never standardized, texts written in *Nôm* vary a good bit from region to region and they also vary over time. Some of this variation can be connected to changes in vocabulary, some to regional variations in pronunciation and some, probably, to gradual changes in the system by which Chinese characters were adapted and used in Nôm. For modern historians and other scholars "Nôm is a precious document of the varieties of regional speech and of how language changed through time."[23] This variation is clearly evident in medical texts, particularly those concentrating on pharmacology, in *Nôm*.

Usage of *Nôm* in Vietnamese Medical Texts

The Vietnamese have always considered pharmacy to be their most esteemed branch of medicine and the majority of Vietnamese medical texts are concerned, to a large extent, with the plants that form the majority of the Vietnamese pharmacopoeia. Like most plants world wide they are known by a variety of "common names" that are often regionally or even locally specific. *Nôm* characters are used in Vietnamese medical texts to formulate terms that are taxonomic in nature as well as to recreate, in written form, the plant names used by the residents of a given area. A good example of a text with a diversity of botanical terms is the early-twentieth-century text Bách Bệnh Kiêm Trị 百病兼治 compiled by Bùi Gia in the fifth reign year of the emperor Khải Định 啓定 (1920). The text is a collection of recipes, advice regarding diagnosis, and descriptions of the preparation and use of various drugs.[24] It is written mostly in *Nôm* with some Chinese for names of diseases, terms for various aspects of diagnostic procedure, and short speculations on etiology.

Not only do *Nôm* characters for the local names of plants appear in medical texts as late as the twentieth century Bách Bệnh Kiêm Trị 百病兼治 but some scholars, including this writer, believe that *Nôm* characters for the names of

[20] (Nguyễn and Stankevitch 1989, 61–4; and DeFrancis 1977, 24).

[21] (Đáo Duy Anh 1975, 63–5; and Durand and Huan 1985, 16).

[22] (Nguyễn and Stankevitch 1989, 58–65).

[23] (Taylor 1998, 972).

[24] (Bùi Gia 1920).

plants were probably among the earliest *Nôm* characters created. The late Professor Trần Quốc Vủng, an esteemed archaeologist and folklorist, considered that one of the earliest extant example of *Nôm* is a local plant name recorded in a Chinese botanical text, the fourth century *Nan-Fang ts'ao-mu chuang* 南方草木狀 by Chi Han 嵇含. This is the earliest extant botanical work on what is now northern Vietnam and southeastern China.[25] In discussing the *Nan-fang ts'ao-mu chuang* Hui-Lin Li, the renowned botanist who translated it, argues that the use of "older, obscure, or less well known names instead of the later commonly employed ones" argues for their early and local, "derivation." Li further states that Chi Han, the author of the *Nan-fang ts'ao-mu chuang* may have found the names of these southern plants "derived or copied from earlier sources."[26] The characters which Professor Vủng considered to be early examples of *Nôm* are 橄欖 which form the name of ***Canarium album*** **Raeusch**, in Chinese Kan-lan 橄欖 and Vietnamese Khâm Trâm.[27]

Within medical texts *Nôm* is most often used to record local names of plants and sometimes toponyms for locations where these plants are likely to be found. In this usage it is not unusual to find *Nôm* characters even in texts that are principally in Chinese. In Vietnamese medical texts in general when discussing prescriptions, or the *materia medica* used to prepare them, a name is given in Chinese if the plant in question has a Chinese name and if that name is known to the author of the text. *Nôm* characters are used to give any widely known Vietnamese name and all of the local names that are known to the author, or authors, of the text in question.[28] Sometimes these names in *Nôm* characters even reflect borrowings from the languages of minority groups such as the Tây or Hmong.[29]

Nôm and the Textual Traditions of Vietnam to 1820

In this context Phan Huy Lê's paradigm of the intertwined evolution of the Vietnamese people, Vietnamese language, and the Vietnamese state is interesting and pertinent. Professor Lê considers that early Vietnamese polities were "made up of many ethnic groups bound by close ties." These ties included "a language that was evolving into a common medium of intercourse."[30] Lê's

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[25] There is a good bit of debate as to the authenticity of this text, see (Ma Tai-Loi 1978, 218–52), in fact there was an entire conference on the subject. Nathan Sivin (personal communication October 1997) considers that after some "8–10 papers it was still a draw" and that the matter is still unresolved. Thus, unless convincing evidence is offered that the text in question is not of the 4th century it should be regarded as the earliest extant herbal on southeast China and Vietnam. (Hui-Lin Li 1979).

[26] ibid., 11.

[27] Trần Quốc Vượng, personal communication, May 1997.

[28] (Thompson 1998, 158–226)

[29] Cung Văn Lược, personal communication November 2004. (Cung Văn Lúc 2004)

[30] (Phan Huy Lê 1988, 35–6).

thoughts on *Nôm* and its relationship to Vietnamese language and culture are equally pertinent; "Việt took definite form with the birth of the *nôm* (demotic) script. . .and evolved into a literary language with the birth of a *nôm* literature (literature in the Việt language). Gradually Việt became a common medium of intercourse among the various ethnic groups."[31] However, in general, "Việt" language expressed in *Nôm* was not the primary writing system used by governments in Vietnam.

While classical Chinese, rather than any form of Vietnamese, was not the only script used by governments and government officials in Vietnam, Vietnam's place in the greater East Asian world, dominated by China and including Japan and Korea, dictated that the primary language of official documents in Vietnam be Chinese. Many members of the Vietnamese upper classes, men and women, became not only literate in Chinese characters but also erudite in the classical literary and philosophical traditions of China.[32] It was only the revolutionary peasant led Tây Sơn (1771–1802) government that used *Nôm* for a significant proportion of its governmental documents.[33]

Nôm is usually noted by scholars as having been a literary language, most of Vietnam's pre-twentieth century literary classics were written in *Nôm*.[34] Within Vietnamese studies it is often assumed that *Nôm* was used primarily for literature and that, prior to the twentieth century, Chinese was used to write almost everything else in Vietnam.[35] However, more recent scholarship has shown that *Nôm* was used extensively in a wide variety of fields. Indeed, an examination of the textual materials held at the Institute of Sino-Nom Studies in Hà Nội and other archives in Vietnam indicates that the amount of material on medicine and pharmacology created by the Vietnamese in *Nôm* makes that writing system crucial to any in depth discussion of pre-twentieth century Vietnamese medicine.

Nôm Medical Texts in the Archive Today

The *Di Sản Hán Nôm Việt Nam-Thủ Mục Đề Yếu; Catalogue Des Livres en Han Nom* is a three-volume annotated bibliography of the holdings, up to 1987, in Chinese and *Nôm*, of the following institutions: Sino-Nom Institute of Hà Nôi, École Française D' Extrême-Orient, Bibliothèque Nationale, Société Asiatique, École Des Langue Orientales, and Musée Guimet all in France. These archival

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[31] Ibid, 38–39.

[32] (Woodside 1983, xix–xxx; Trần Nghĩa 1989, 34; Kelley 2005).

[33] (Dutton 2006, 17, 28, 238n)

[34] Vietnam's most famous work of literature *The Tale of Kiều,* the anonymous epic poem *Phan Trần* and many of the poems of Nguyễn Trài, Nguyễn Bnh Khiêm, and Hồ Xuân Hủng were originally written in *Nôm* although they are most commonly seen today in *Quôc Ngū* editions. (Durand and Huan 1985; Huỳnh Sanh Thông 1979, 1996)

[35] (Hodgkin 1981, 92; Marr 1981, 139–45)

collections of materials from Vietnam, were begun during the French colonial period and the holdings of the Sino-Nom Institute have been further enlarged since independence from France in 1954.[36] There are annotations for over 16,000 items written in Chinese, *Nôm*, or a mixture of the two. Particularly within the field of medicine, there are numerous works in which one full section is written in *Nôm*, another in Chinese and yet another in *Hán-Nôm*. A *Hán-Nôm* text is formally defined as a text in which *Nôm* characters are interspersed with Chinese characters at the level of the paragraph.[37] This use of both Chinese and *Nôm* within one text "is the type of texts [sic] with the longest record of existence in the Vietnamese nation's history."[38]

Some of the texts in the collections covered by the *Di Sản Hán Nôm* originally came from China, however, the majority were produced in Vietnam. The items in these collections came from all regions of Vietnam, and their dates span a very broad time period.[39] Given the size and diversity of this collection, clearly these texts are representative in terms of subject matter, time period, and script used, of the textual traditions of Vietnam. The *Di Sản Hán Nôm* notes 366 entries solely on medicine and/or pharmacy: 186 of these are written in Chinese, 50 in *Nôm*, and 130 in some mixture of the two scripts. In general, the sections in *Nôm* in these mixed language texts are not translations of Chinese sections of the same text, instead they present different subject matter-most often local pharmaceuticals and their use and preparation. Many of the texts listed are works in several volumes, entries were counted but not individual volumes. Included in this count were works on pharmacy, dietetics, physical hygiene, forensic pathology, veterinary medicine and all branches of what would commonly be considered medicine. There are also at least 161 other texts which contain some mention or discussion of medical and/or pharmaceutical matters.[40] Of these texts 85 are in Chinese, 16 in *Nôm*, and 60 in a mixture of the two scripts. Of these mixed script texts it is significant that in at least half of them the section that is on medicine is written in either *Nôm* or in what would be considered by scholars at the Institute of Sino-Nom Studies to be *Hán-Nôm*.

As for those texts on medicine or pharmacy written in Chinese, at least one-third of them were imported from China and can be ignored when assessing the languages that Vietnamese authors used to create medical and pharmaceutical texts. Calculating the percentages of texts on medicine or pharmacy written by

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36 (Henchy 1998, 2–7).

37 Hoàng Văn Lâu, personal communication January 1994.

38 (Nguyễn Quang Hồng 1992, 1143).

39 This time frame can be considered to be 1329 through the 1960s. However, some of these works are copies of earlier texts which are no longer extant.

40 To calculate this number I read the annotations of all of the entries in the *Di Sản Hán Nôm*. While these annotations are remarkably thorough, and for the texts I have examined myself they are highly accurate, it is possible that some medically related topics contained in a given text were not noted by the annotators thus the number of books which contain bits on medicine or pharmacy could only be higher, not lower, than my own count.

Vietnamese authors results in a figure of approximately 40.8% in Chinese, 16.4% in *Nôm*, and 42.8% in *Hán-Nôm*. Adding together those in *Nôm* and *Hán-Nôm* results in a figure of 59.2%. This makes it clear that more than half of the texts on medicine and pharmacy produced in Vietnam were written in either *Nôm* or *Hán-Nôm* rather than in "pure" Chinese.

For some medical subjects, smallpox for example, the percentage of texts written in *Nôm* or *Hán-Nôm* is even higher than the percentage of texts in *Nôm* and *Hán-Nôm* for general medical and pharmaceutical texts. The *Di Sản Hán Nôm* lists 58 entries specifically on smallpox and there are other works, both medical and non-medical, with an entry, whether just a few sentences or a number of pages, on smallpox.[41] Of these works, nineteen are in Chinese, seven in *Nôm* and thirty-two are divided into sections by languages or are in *Hán-Nôm*. Of the works in Chinese, four were imported from China and fifteen were produced in Vietnam. So, of books on smallpox, in this collection, produced in Vietnam (54), 27.7% are in Chinese, 12.9% in *Nôm* and slightly less than 60% are a mixture of scripts. Nearly 73% of the works on smallpox written in Vietnam are written entirely in, or contain, *Nôm* or *Hán-Nôm*.

Although there has been no detailed count of Vietnamese texts on other branches of traditional sciences or mathematics such as this analysis of medical texts, it appears that texts written in *Nôm* and *Hán-Nôm* are as important, in terms of sheer numbers, to the study of other subjects, such as engineering or agriculture, as they are to medicine. These figures make it obvious that research on any branch of Vietnamese literate traditions of scholarship on medicine, science, and technology prior to the expansion of the use of *Quôc Ngū* in the 1920s, requires the use of texts written in *Nôm*.

Examining General Assumptions Concerning*Nôm*

Since this is so then why is *Nôm* generally described by scholars, both Vietnamese and Western, as having been used mainly for literature? And why has it been true, until very recently, that within Vietnamese studies the assumption has been that *Nôm* was used for literature, for recording folk humor and folk tales, and for political protest but that Chinese was used to write almost everything else in Vietnam prior to the twentieth century?[42] Further, let us revisit the subject of full versus functional literacy and ask again why it is so often said that to be literate in *Nôm* a person had to be literate in Chinese?

To address the first question the answer is that *Nôm* was indeed a writing system that was magnificently capable of expressing the vivid and subtle

[41] All works on pediatrics and most works on obstetrics contain a section on smallpox. As for non-medical works which include text relating to smallpox, a good example is the *Bảo Huấn Hợp Biến*,Vinh Phú (1876) a Buddhist text which contains, at the very end, several medical prescriptions for treating intestinal problems and smallpox.

[42] (Hodgkin 1981, 29, 49, 64–5; Tarling 1992, 243; Woodside 1988, 51–4).

nuances of Vietnamese language. *Nôm* is a superb literary vehicle and the brush of a master poet such as Nguyễn Du was capable of "triumphantly rescuing Vietnamese from the stranglehold of classical Chinese" and performing "for the vernacular what Dante had once done for Italian, liberating it from its position of subservience to Latin."[43] However, the majority of literate people in any society fall far short of the standards of renowned poets and the sheer number of texts written in *Nôm* that make no claim to being "literary" indicates that fairly ordinary people used *Nôm* for a variety of other purposes.

To address the second and, in part, the third questions it can be said that examples of *Nôm* used for literature, including political commentary and protest, exhibit sophisticated bilingual and biscriptural plays on words that could only be made by a writer fluent in both Chinese and Vietnamese and also thoroughly familiar with Chinese philological precepts.[44] However, there is an assumption behind the second and third questions above that gives an indication as to why scholars who work on pre-twentieth century Vietnam have clearly privileged texts in Chinese over those written in *Nôm*. In the field of history of medicine this elevation of texts in Chinese can clearly be seen in the seminal work of the French educated Dủng Bá Bành M.D. Dủng Bá Bành was the first scholar to attempt to write an overview of the history of Vietnamese medicine. As part of his *Histoire de la Médecine du Việt-Nam* (1947–1950) the author included an annotated bibliography of Vietnamese medical texts. Clearly these were the texts that Dủng Bá Bành considered most important. Of the 58 texts discussed 41 are written in Chinese, four are known to have been primarily in Chinese but with some *Nôm* for names of plants, and only one is written in *Nôm*.[45]

Dủng Bá Bành's work has been tremendously influential in part because of the sheer rarity of scholarly work, written prior to the 1980s, that describes Vietnamese medicine in any sort of a broad framework. However, Dủng Bá Bành clearly regards Vietnamese medicine as simply an offshoot of Chinese medicine. Indeed, he most often uses the term *médecine sino-vietnamienne* to refer to Vietnamese medicine. Not surprisingly many later scholars have followed Dủng Bá Bành's lead in this matter to one extent or another.[46] Dủng Bá Bành's emphasis on Chinese language sources accords with general trends in historical scholarship regarding Vietnam.

Scholars appear to assume that works in Chinese are more important to the "history" of Vietnam than works in *Nôm* are.[47] A corollary to this is the idea that those who wrote non-literary texts in *Nôm*, with little if any Chinese in their

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[43] (Huỳnh Sanh Thông 1983, xxi).

[44] (Nguyen Nam 1992, 15–6; Boltz 1994, 138–55).

[45] (Dủng Bá Bành 1947–1950, the script, or scripts, used in twelve of the texts has not been determined).

[46] (Hoang Bao Chau et. al. 1993, 11; Marr 1987).

[47] Please see the bibliographies of (Dủng Bá Bành 1947–1950; Woodside 1988; Taylor 1983 and 1998; and Choi Byung Wook 2004).

texts, were only semi-literate and thus their texts cannot possibly be important or even very interesting. In a sense this simply reflects the fact that within the field of history, and the scholarship on pre-twentieth century Vietnam belongs mainly to historians, political history still dominates all other types of historical study. Most of Vietnam's extant, and most easily available, pre-twentieth century primary documents on political events and actions are in Chinese so it is natural that these historians consider that documents in Chinese are more important for their purposes than those in *Nôm*.

However, for some decades now there has been a major effort to balance top down political history with bottom up cultural history and for this to apply within Vietnamese studies texts in *Nôm* must be taken into account. To accomplish this yet another question must be asked and also answered. That question is how did Chinese come to be privileged over *Nôm* outside the realm of official court documents? The evidence indicates that this privilege is connected to a social condition, which arose during the reign of Minh Mạng (明命 1820–1841). That is, a push from the royal government for "Sinicization" or "Confucianization" of the scholar gentry, the social class which prided itself on its scholarship and which provided the pool of talent from which government officials were chosen through the imperial examination system. The case of medical texts will provide a case study of the decline in status of *Nôm* as a writing system and the accompanying abandonment of *Nôm* by those seeking social status.

Impact of the Nguyễn Dynasty

At the time when French observers first commented on healers and on medical practice in Vietnam there was one group of physicians with a formal structure whose hierarchy was arranged by, and who were attached to, the Nguyễn royal court.[48] The founder of the Nguyễn Dynasty, Nguyễn Phúc Anh (reign name Gia-Long 嘉隆 1802–1820), established a royal medical service in 1805. The emperor's method of structuring the royal medical bureaucracy was a transformation of the relationship between medical practitioners and the royal court.[49]

Prior to the Nguyễn, most healers invited to attend the members of the royal courts of Vietnam were summoned because they had won some renown as physicians of one sort or another outside the purview of the royal court. Most often they were *not* members of the imperial bureaucracy before being summoned to court nor had they, in most cases, been through the imperial exam system. If they belonged to any organized group it was likely to be the Buddhist sangha, as the career of one of Vietnam's two most famous physicians

48 (Marr 1987, 177–8; Henry 1898, 156–8; LeClere 1897, 350–1).

49 The design of the medical service was initiated by Gia Long, his son Minh Mạng made major contributions to its final format and various other Nguyễn emperors made minor adjustments. (Dùng Bá Bành 1947–1950, 47–50).

illustrates. Tuệ Tĩnh was a Buddhist monk, indeed the name by which he is known is a religious title rather than a personal name.[50]

This changed dramatically under the Nguyễn court medical hierarchy. In Gia Long's 1805 initiative, five grades of Palace Physicians were established; 4 years later provincial medical authorities (Lùơng Y) were designated. Further expansion of this government medical hierarchy followed under Minh Mạng (明命 1820–1840).[51] The most significant break with the past was the involvement of the court in *training* physicians. The establishment of a hierarchy of physicians employed by the government rested, at first, on the training of physicians of the lower orders by those of the higher in the sort of medical apprenticeship that was already the traditional route to a career in medicine in Vietnam. The royal courts of Vietnam had never before involved themselves in the training of healers or physicians of any sort. As time went on the Nguyễn moved somewhat away from the pure apprenticeship mode of training and eventually founded a medical school to train physicians for the royal medical service. After the establishment of this school, in 1850 by order of Emperor Tự Đức (嗣德1847–1883), a course of study relying on "Les livres chinois traitant de la médecine et de l'histoire naturelle des plantes" was designed.[52] Thus some 30 years after the death of Gia Long the Nguyễn court came to assign Chinese texts for its medical students. Gia Long had gone beyond merely tolerating *Nôm*. The first emperor of the Nguyễn had actively encouraged its use by promulgating a decree, in 1814, which required that the secretariat for the northern administrative region have members who could use both *Nôm* and Chinese.[53]

However, Minh Mạng disagreed with his father (Gia Long) about many things, among them *Nôm*. Shortly after he ascended to the throne, in 1820, "he attempted to deal a death blow to *Nôm* at the Huế court by ordering that from then on all memorials, and all compositions written at Vietnamese examination sites, be written in characters identical to those in the imported [Chinese] K'ang-hsi dictionary." Secretaries were required to know four calligraphy styles, "all of them were Chinese . . ."[54] After 1832 the use of books containing *Nôm* was prohibited during even the second stage of the examinations.[55] As far as is known, the medical school, the examinations to enter it, and all medical activities under royal auspices were forced to abide by these regulations as well.[56]

Minh Mạng proscribed writing in *Nôm* for all official documents and prohibited the use of texts written in *Nôm* for any administrative purpose by

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[50] Tuê Tĩnh's birth name was Nguyễn Bá Tĩnh. (Thompson 2006)

[51] (Hoang Bao Chau et al. 1993, 13; Marr 1987, 177).

[52] (Silvestre 1889, 174; Dủng Bá Bành 1947–1950, 50).

[53] (Woodside 1988, 54).

[54] ibid., 54–55.

[55] ibid.

[56] Alexander Woodside states that he knows of no special allowance for the use of *Nôm* in either the royal medical school or the royal medical service. Personal communication, Jan. 27, 1998.

members of the Vietnamese court and the Vietnamese administrative bureaucracy not only in the capitol city of Huế but also in the provinces. Minh Mạng also began to revamp the royal medical service shortly after Gia Long's death.[57] Indeed the official title, Thái Y, given to the doctor who compiled the report on the last months of Gia Long's life did not exist during Gia Long's life.[58] It was Minh Mạng who created this title along with a bureau under the supervision of the holder of this title. Minh Mạng's revamping of the royal medical service intensified during the mid to late 1820s. Minh Mạng applied regulations of the court, such as his restrictions on use of *Nôm*, to the medical service and added regulations concerning the use of certain medicaments.[59]

Between 1824 and 1832 Minh Mạng took steps to block many potential sources of opposition. This involved enforcing the prohibition against use of *Nôm* and in 1832 extending this prohibition not only to the essays written for the second level of the regional scholarly examinations but even to the books candidates were allowed to use in preparation for the exams.[60] By 1824 *Nôm* had become too associated with not only the Tây-sn, who had been defeated by Gia Long, but also with rebels against the Nguyễn such as Phan Bá Vành for Minh Mạng to regard use of it as anything other than subversive.[61] As time passed Minh Mạng's suspicions regarding *Nôm* and those who used it were strengthened by the growing number of Catholic texts being written in *Nôm*, including some that were not only widely distributed but were also clearly seditious.[62]

The evidence indicates that Vietnamese healers of the time who used *Nôm* did so, for the most part, because it seemed appropriate to use local names of the plants in the Vietnamese pharmacopoeia. After all many local plants had no Chinese name. Textual evidence reveals that it seemed more proper to the authors to write the names of the indigenous plants used in the prescriptions in *Nôm*. Indeed, in one genre of Vietnamese medical texts, those on botanical products used for both medicine and food, names of plants are almost always given in *Nôm* even when they are also given in Chinese and when the text on their preparation and use is in Chinese. One good example of this kind of text is the eighteenth-century *Bản Thảo Thục Vật Toản Yếu*, 本草食物簒要 compiled by Phan Phu Tiên. In this work the handwritten text is in Chinese except for the additional noting of many plant names given in Chinese with local names also

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[57] (Dủng Bá Bành 1947–1950, 47–8).

[58] The official account of Gia Long's final illness can be found in *Records of the Grand Physician*. Nguyễn Thuôc Phiên. 18th year 1st to 12th month (February 1819–January 1820) of the Reign of Gia Long. Microfilm of the Châu Bản. (Vermillion Books) of the Nguyễn Dynasty held by Harvard-Yenching Institute. Roll 5. no. Fe1070.

[59] (Sallet 1931, 120–1).

[60] (Woodside 1988, 55).

[61] ibid., 57.

[62] Catholic texts in *Nôm* were produced in fairly large numbers from the seventeenth century on. For a discussion of one "openly subversive" text see Woodside, *Vietnam*, 58.

given in *Nôm*. The name of this work indicates that it is primarily concerned with plants used as foodstuffs rather than as medicine, but dietetics is an essential part of Vietnamese medicine and many plants are used for their nutritional properties specifically to counter certain climatic or life cycle conditions.[63]

This reasoning regarding local terms for *materia medica* did not soften Minh Mạng's attitude towards use of *Nôm* on the part of Vietnamese physicians. Minh Mạng and the emperors who followed him encouraged a sinification of the medical service as they encouraged adherence to Chinese forms and customs throughout the Nguyễn bureaucracy. This was certainly true in regard to the texts studied in the royal medical school and in the texts produced by physicians in the royal and provincial medical hierarchies. The Chinese medical classics were the principal texts studied for the Nguyễn Dynasty medical service[64] and the texts produced by the doctors in this service were written in the standard Chinese characters approved by the Qing Dynasty. In contrast, use of texts in *Nôm*, as well as the writing of new medical documents in *Nôm*, were prohibited for healers who worked for the Nguyễn.[65] These restrictions on written format, and a corresponding requirement that Vietnamese scholars interested in joining the royal bureaucracy be conversant with the Chinese classics, led to a distinct split, a class divide, in the genres of Vietnamese medical literature which were produced from the reign of Minh Mạng on.

The Nguyễn royal family was quite large. The first emperor, Gia Long, had 22 children, his son the second emperor, Minh Mạng, was especially prolific and sired 126 children while the third emperor, Thiệu Trị, clearly tried to uphold the family tradition of fertility by fathering 57 children. While records indicating the number of physicians employed by the palace medical service are no longer extant it can be assumed that with a royal family this large and five known ranks of physicians serving only the royal family and other residents of the palace that a fairly large number of healers worked for the royal medical service.[66] The five ranks in the hierarchy of the *Thào y viện* (Palace Medical Service) were "*Ngự sủ* (Physician of the King), *Phó ngự sử* (Assistant Physician of the King), *Chánh y* (Palace Physician), *Phó y* (Assistant Palace Physician), and *Y viện* (Subaltern Palace Physician)."[67]

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[63] Phan Phu Tiên, comp. Eighteenth century compilation based, in part, on a fifteenth century work.

[64] Scholars such as Dủng Bá Bành and Hoang Bao Chau note that the course of study was based on several of the Chinese medical classics. However, except for the *Huang Di Nei Jing (The Inner Classic of the Yellow Emperor)* the sources do not discuss which Chinese medical classics were used.

[65] It is not certain how strictly this ban was enforced.

[66] These records and others were most probably destroyed in the intense fighting around the former royal citadel during the Tết Offensive of 1968.

[67] (Hoang Bao Chau 1993, 13).

Outside the palace walls and the capitol city the Nguyễn emperors continued their unprecedented involvement in health care with several public health initiatives. In 1809 a provincial health service was established, however it took several years before most of the provinces actually had court appointed health officers. This bureau was charged not only with providing at least some care to the human residents of the provinces, including shelters (*Dưỡng Tế Sự*) for the indigent sick and elderly, but also with veterinary services, including inspection of elephants destined for royal service.[68] The provincial health bureaucracy was expanded under Minh Mạng and the same regulations applied to recruitment and work for this service as to those for all other government institutions.[69]

Only a small percentage of the healers working in Vietnam ever entered the Nguyễn royal medical service or the provincial medical services. Most healers continued to train in the traditional manner through an apprenticeship, and the "profession of physician for ordinary people was open to anyone."[70] However, the Nguyễn court's "initiatives were designed to incorporate a portion of existing medical beliefs to the dominant Neo-Confucian political ideology" and one thing these initiatives did was to first create and then entrench a social gulf between physicians recognized by the court, in Huế, or by its appointees, in the provinces, and those outside that sphere.[71] This creation of a Huế centered elite affected all branches of the bureaucracy and exacerbated regional as well as class divisions.[72] Indeed, as the "Sons of the political elite marshaled their advantages, in particular the inherited right to government stipends while studying at the National College in Hue," it became increasingly difficult for those outside this system to enter it.[73]

Conclusion

In Vietnam this type of political and class differentiation, with the Confucians generally on top, had not been a major force in the medical profession until the Nguyễn Dynasty. Neither of Vietnam's two most famous doctors, before the Nguyễn, concentrated on Confucian scholarship.[74] Tuệ Tĩnh and Lán Ông, the two Vietnamese physicians who are generally regarded as the two most "outstanding figures" in Vietnamese medicine, had strong Buddhist and Taoist connections and neither ever willingly worked for long periods of time at the

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68 (Dủng Bá Bành 1947–1950, 47).

69 For an in depth discussion of the recruitment and promotion process see (Cooke 1995).

70 (Hoang Bao Chau 1993, 4).

71 (Marr 1987, 178).

72 (Cooke 1995)

73 (Cooke 1995, 763)

74 Some scholars assert that both of these men actually trained in the Confucian exam system and did well in the examinations but refused to enter the imperial bureaucracy. (Hoang Bao Chau 1993, 16–20)

royal court.[75] Tuệ Tĩnh 慧靖 was a fourteenth-century Buddhist monk who was also a highly respected doctor and pharmacist.[76] Lán Ông, in contrast, had Taoist leanings, his real name was Lê Hu Trác but he is generally referred to as Lán Ông (懶翁), a pseudonym which Vietnamese scholars consider to have strongly Taoist overtones. Sometimes Lán Ông is referred to as Hải Thùng Lán Ông meaning Lán Ông native of Hải Thùng.[77] Lán Ông was a physician who lived and practiced medicine during the civil wars of the eighteenth century.[78] He wrote in both Chinese and in Nôm as did Tuệ Tĩnh.

The fame of Tuệ Tĩnh's only work written primarily in Chinese illustrates the privilege accorded Vietnamese medical texts in Chinese during and after the Nguyễn dynasty. One of Tuệ Tĩnh's major medical treatises, the *Nam Dừợc Thần Hiệu* 南藥神效 [Miraculous Drugs of the South], was written while he lived at the Ming court.[79] The work was designed to systematize the use of southern medicaments within the parameters of Chinese drug theory and to present "southern" medicine to physicians in China. The *Nam Dừợc Thần Hiệu* is generally noted as being Tuệ Tĩnh's major work and also as being his most influential.[80] However, Tuệ Tĩnh also composed several other works, most notably the *Hồng Nghĩa giác tủ y thủ (Medical Books by Hong Nghia)*.[81] The *Medical Books by Hong Nghia* presented Tuệ Tĩnh's medical philosophy, specific advice, and prescriptions in poetic format, primarily in *Nôm*. That made it easy for ordinary people to read and to remember. This text addressed the common everyday afflictions of ordinary people and of their livestock, most of the ingredients for the prescriptions could be found in or around most village gardens or in the nearby forests. This work became a standard practical medical reference for Vietnamese traditional healers centuries before it was first presented to the royal court of the Lê Dynasty (1428–1788) in 1717 and thereafter printed for the first time. Indeed the *Hồng Nghĩa giác tủ y thủ* "could be widely disseminated because it was written in demotic characters (*nôm)*."[82] The Lê Emperor understood this and ordered a council of physicians to review the various documents and copies available and had the *Hồng Nghĩa giác tủ y thủ* printed in 1723.[83] The supposedly more influential and more widely used[84] *Nam Dừc Thần Hiệu* was not printed in Vietnam until 1761.

[75] (Hoang Bao Chau 1993, 15).
[76] (Thompson 2006, "Tuệ Tĩnh").
[77] (Hoang Bao Chau 1993, 20; Thompson 2006, "Lán Ông").
[78] (Vũ Văn Đ;ình trans. 1993, Nguyễn Trần Huàn trans. 1972 and Thompson 2006, "Lán Ông").
[79] (Thompson 2006).
[80] (Dủng Bá Bành 1947–1950, 73–4; Marr 1987, 170–1; Hūu Ngoc and Lady Borton 2003, 25–7).
[81] Hong Nghia is a pseudonym for Tuệ Tĩnh.
[82] (Hoang Bau Chau 1993, 18).
[83] (Nguyen Kiet Chi 1986, 49).
[84] (Hūu Ngoc and Lady Borton 2003, 25).

Tuệ Tĩnh is important enough to the history of Vietnamese traditional medicine that, although the *Nam Dủc Thần Hiệu* is generally regarded as his most important work, his texts in *Nôm* receive some acknowledgement. For instance, the *Hồng Nghĩa giác tủ y thủ* is the only *Nôm* text in Dủng Bá Bành's annotated bibliography. However, the texts in *Nôm* of dozens of less well known physicians have received almost no scholarly attention and it is not known just what information they might contain that could perhaps radically expand our knowledge of medicine as it was most commonly practiced in Vietnam until well into the twentieth century.

Minh Mạng's 1820 proscription on the use of *Nôm* resulted in a highly privileged position for Chinese in the Vietnamese government and in the imperial examination system in Vietnam. This led to a corresponding decline in the use of *Nôm* among the scholar gentry, in general, and in the medical texts produced by members of this group after 1820.[85] Users of *Nôm* became marginalized as a social class within the community of healers in Vietnam due, in large part, to nineteenth and early twentieth-century restrictions on use of *Nôm*. By the time France had completed its conquest of Vietnam, in the 1880s, Chinese had held a governmentally supported and privileged position for over 60 years. The prescriptions referred to, by an early colonial era French observer, as "secret" and as "secret family recipes handed down from father to son through a line of ancestors" may not have been so much "carefully guarded secrets" as recipes containing local names of plants written in *Nôm*.[86] These names might not be well known by the general public, however more than one name for a given plant would be known by most traditional healers and pharmacists meaning that to those who cold read them there was nothing *intentionally* secret about these texts.[87]

A preliminary analysis of the texts, in Hán and in *Nôm*, concerning one specific medical problem, smallpox, indicates that texts written in *Nôm* reflect a substratum of Vietnamese medical knowledge and traditions which continued to thrive and evolve under an overlay of Chinese importations.[88] We also know that *Nôm* texts contain linguistic information on regional pronunciation, local toponyms, names for local flora and fauna, and on other local and specific terminology which is pertinent not only to the history of medicine in Vietnam but also to many other fields of study regarding pre-modern Vietnam.

The long history of Vietnamese traditional medicine has been distorted by the fact that by the time of French colonization most of those who could be considered elite physicians used mainly Chinese for their medical literacy. While

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[85] (Thompson 1998, 158–226)

[86] (LeClere 1897, 350).

[87] In numerous conversations traditional healers and pharmacists in Vietnam emphasized that they had to know several common names for most medicinal plants. Several of them also noted that this was part of the value, to them, of medical records kept by their ancestors as uncommon (to their own area) names of plants were often recorded therein.

[88] (Thompson 1998).

it is very clear that Chinese medicine has had an enormous impact on Vietnamese medicine, we can determine more clearly the form and the shape of that impact if we take the full range of Vietnamese medical expression into account in evaluating the Vietnamese response to this impact. Much of that response is written in *Nôm*.

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